August

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SSUE

Science and Invention

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ELECTRICA ENTER

THE TRUTH ABOUT PERPETUAL MOTION

See Page 338

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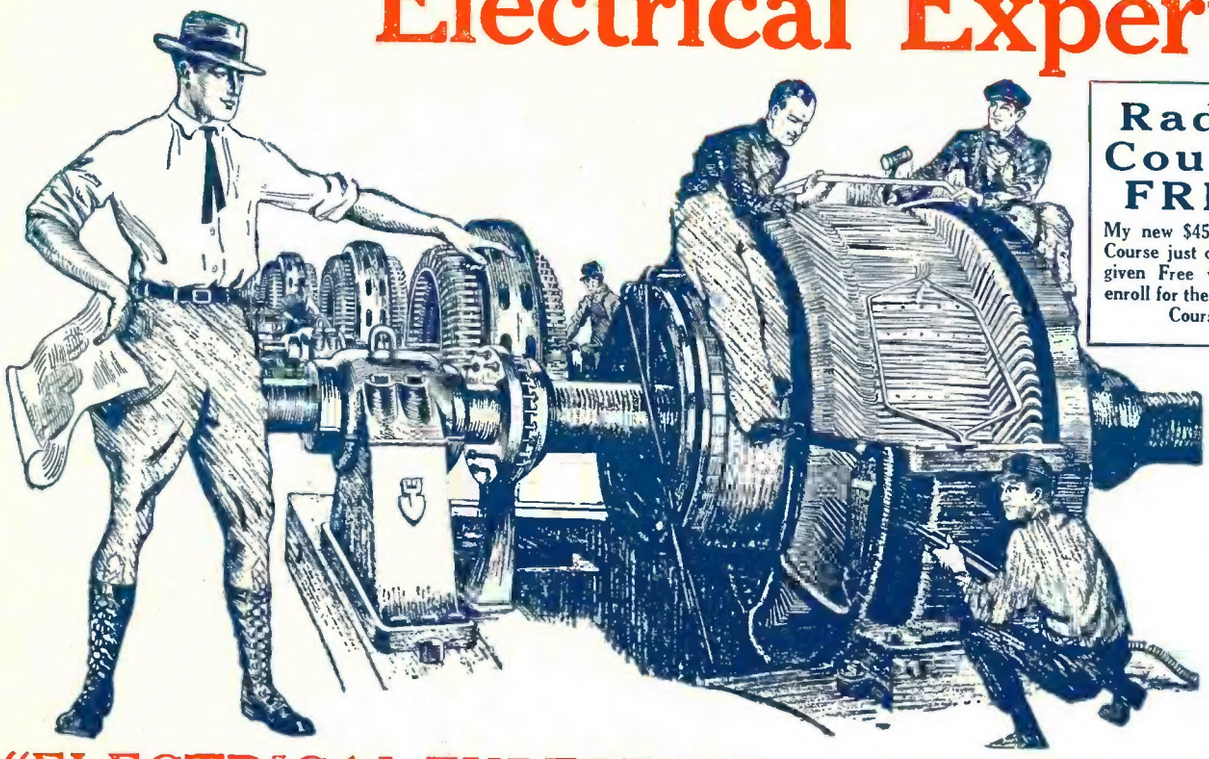

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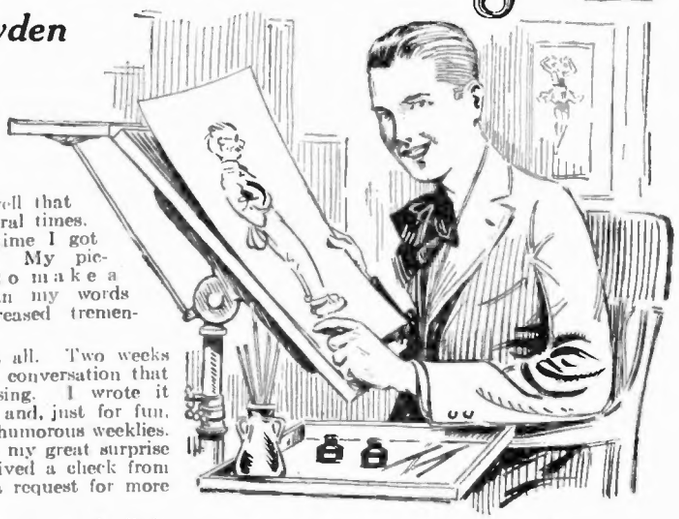
YOU CAN DO IT

How In One Evening I Learned The Secret of Drawing

By Walter Sayden



The most fascinating Business in the World

FROM boyhood, I have always wanted to draw things. I suppose there are hundreds of young fellows who feel the same way as I did. I often said that if it were possible, I should choose commercial art as a profession. It was not only the big salaries and independence enjoyed by artists and cartoonists that appealed to me, it was the fascination of the game itself.

He was drawing little pictures

But I could hardly draw a straight line. My friends used to have laughing hysterics at my attempts to sketch things.

One morning, as I was coming into town on the eight o'clock train, I met Larry Stafford. I had come into town with him every day for years, usually passing the time discussing the morning papers.

But this particular morning he had a pad and pencil in his hand. He was drawing little pictures of things that looked like a series of small animals.

"What on earth are you doing?" I asked in amazement.

Larry smiled. "Don't be afraid, I am quite sane. These little pictures are part of a scheme of mine. I am illustrating an idea. They are supposed to be a graphic representation of a deal I am putting over. They speak louder than words."

I watched him—amazed to see that he drew very well indeed. As he proceeded, and the drawings became more life-like, my curiosity was aroused—I asked him about it.

"Why, I am surprised that you ask me!" he answered. "Look how easy it all is," and he quickly sketched a few other figures and grinned at my amazement.

"There is just one little secret of the whole thing, Walter," he added. "I never drew before in my life, and you see—these little sketches are really not bad, are they? You have always wanted to draw, and even if you don't become an artist, you will find it a mighty convenient thing to know. This secret makes drawing as easy as writing. Let's get together this evening and I'll show you how simple it is. I'll give you a little lesson."

Mr. Charles Lederer, the well-known newspaper cartoonist, after years of practical working experience, has developed one great, simple rule for success in all branches of commercial art. This amazing secret has revolutionized the entire theory of drawing. It means that drawing can be easy for *you* as writing. Out of his many years of work-a-day experience, Mr. Lederer offers this One Big Secret of Drawing to all.

The Greatest Surprise of My Life

That night I was astonished to learn that there was but One Great Rule that covered every sort of drawing. I mastered this rule in just fifty minutes, and in two hours found that I could draw. Think of it! It was almost like magic. I had never before been able to draw a recognizable object.

At this time I was a salesman, so that the only time that I had to practice and apply this secret, this Rule, was in spare minutes when at the office or at home. But I progressed with almost unbelievable rapidity.

My First Real Drawing

One day I was talking with a buyer. Remembering Larry's "idea-pictures," I drew some figures to illustrate the point I was trying to establish. He looked at the pictures and caught my idea at once. Before I left he gave me a larger order than I had ever before received from him. *My pictures* had put my idea over.

This worked so well that I tried it again several times, in fact—and each time I got the same results. My pictures seemed to make a stronger appeal than my words and my sales increased tremendously.

But that was not all. Two weeks later I overheard a conversation that struck me as amusing. I wrote it down, illustrated it and, just for fun, sent it to one of the humorous weeklies. A few days later, to my great surprise and pleasure, I received a check from the art editor and a request for more contributions.

From that time on I sent in little sketches and jokes more or less regularly. A few months ago I received an offer which startled me. The magazine for which I had been drawing wished to take me on the regular staff at a much greater salary than I was then making.

My love of drawing came strongly to the front and, needless to say, I accepted at once, and the first thing I did was to tell Larry Stafford what his idea had led to. When he heard that I was actually a successful artist on a real magazine he gasped with amazement.

I told him how the same One Great Rule of drawing which had made it easy for him to draw had meant even more to me—and how this simple home-study course by a famous artist, Charles Lederer, which we had gone over that evening, had given me the secret which had meant so much.

Larry laughed at my enthusiasm, but admitted that such a remarkable success as mine was enough to make a man a bit optimistic.

Easier Than Learning to Operate a Typewriter

Through this amazing system, drawing can be *taught* as easily as anything else. In his simple, home-study course a world-famous cartoonist, Charles Lederer, teaches you to draw just as a business school teaches you to keep books or operate a typewriter or write shorthand. But it is a hundred times simpler than any of those accomplishments.

And the best part of it all is that the course teaches you to draw so that you can *sell* your pictures right from the start. That is really the most important part, after all. Everyone wants to sell his work, and that is just what you can do, with Mr. Lederer's great secret.

Don't misunderstand; I am not praising myself. The point is this—if I, who never was able to draw at all, could achieve this really remarkable success, others can do the same or better.

See for yourself—send for the course and try it out. If you can draw at all you will probably get along even faster than I, and you will find modern commercial art the most fascinating and delightful work imaginable.

Remember, that opportunities in this uncrowded field are unlimited. There is a constantly growing demand for cartoonists and illustrators. If you like to draw or if you *think* that you *would* like to draw, don't miss this wonderful opportunity to learn in an evening or two of your spare time.

Five Days' Free Trial

We want you to prove to your own satisfaction the tremendous value of Mr. Lederer's discovery. It will not cost you one penny. We want you to examine the Entire Course at our expense for five days. If you will just fill out the coupon below, detach it and mail it to us, we will gladly send you the complete course for your approval. We feel sure that when you see the surprising simplicity of this method you will agree with us that it is the greatest discovery ever made in this field.

Look it over, test it out—then, if after five days you decide that you want it, send us $3.00. If you do not wish to keep it, return it to us and forget the matter.

But act AT ONCE. Learn to draw—whether or not your aim is commercial art. It is a big asset, no matter which field you are in. Let us disclose to you the whole secret. Detach the coupon and mail TODAY.

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people have paid $5 or $7 for one of our Self-Improvement Courses—and remember no one was asked to pay until he had five days to examine the course in his own home.

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Vol. X
Whole No. 112

Science and Invention

FORMERLY

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No. 4

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What did America get out of the War? You often hear that question asked, yet few people realize just what material advantage the United States did gain. She gained industrial supremacy. Hundreds of manufactures formerly almost unknown here, have come to this country to stay. With hardly an exception they belong to the so-called Chemical Industries, for which the services of trained chemists are essential. The dyestuff industry alone gives employment to thousands of chemists, for whom there was little demand prior to 1914. Outside of the laboratory there are innumerable executive positions which can be filled only by men who understand chemistry.

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Did you know that **carborundum,** the universal abrasive, was unknown until E. A. Acheson, another American chemist, discovered it in 1891?

Did you know that **silicon,** an important ingredient of special steels, fell from $100 an ounce to 10 cents a pound, due to a cheap method of production evolved by American chemists?

Did you know that the dye, **indigo,** dropped from $4.00 a pound to 15 cents a pound when the chemists learned how to prepare it in the laboratory?

Did you know that between 1914 and 1917 the **American dye exports** jumped from 2 million to 57 million pounds?

Did you know that **vanillin,** the flavoring principle of vanilla, was reduced in price from $800 a pound to $10 a pound when chemists perfected a method for its synthesis?

Did you know that John Hyatt, an American chemist, invented the useful commodity, **celluloid?**

Did you know that **Thorium Nitrate,** used in gas-mantles, sold for $200 a pound in 1895? In 1916 it was priced at $2.60 a pound, due to improved chemical methods of refinement.

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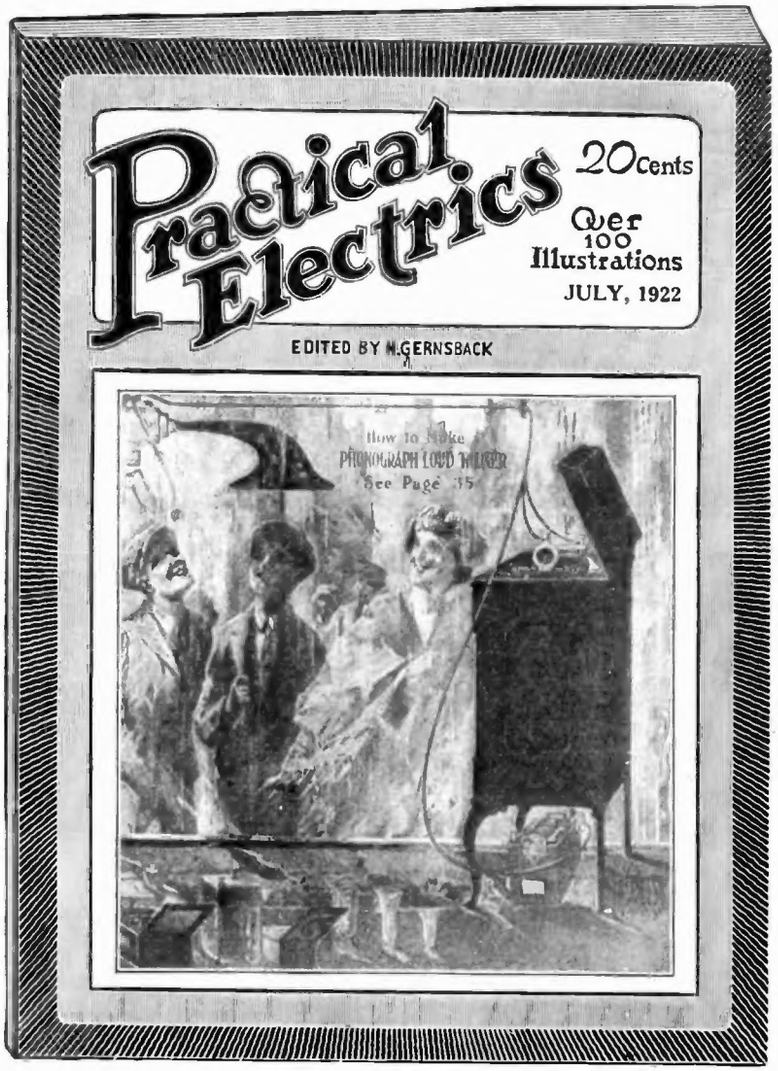

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The July issue contains 48 pages and over 100 different articles and over 100 illustrations, with an artistic cover in two colors. Professor T. O'Conor Sloane, Ph.D., is associate editor of the magazine.

Leading Articles in the July Number

Automatic Train Control, by Frank J. Sprague. Electrogeoscopy, by T. O'Conor Sloane, Ph. D. A Laboratory Ultra-Violet Electric Lamp. True Electrical Experiences (Continued), by H. Winfield Secor, Assoc. Member, A. I. E. E. Thermo-Dynamic Electricity by F. R. Kingman. Tesla's Electrolytic Clock.

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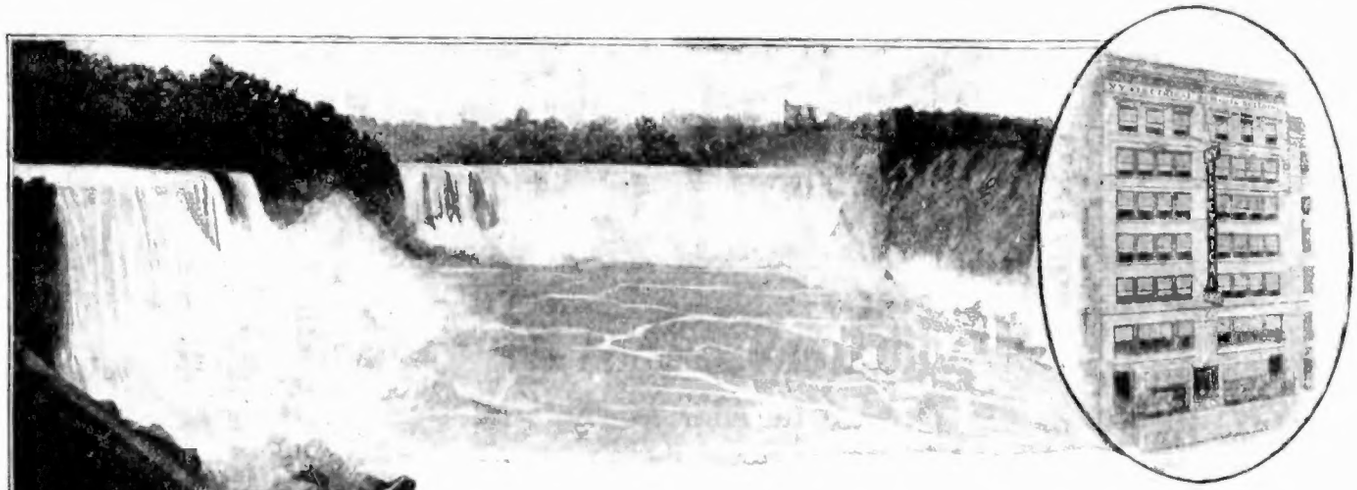

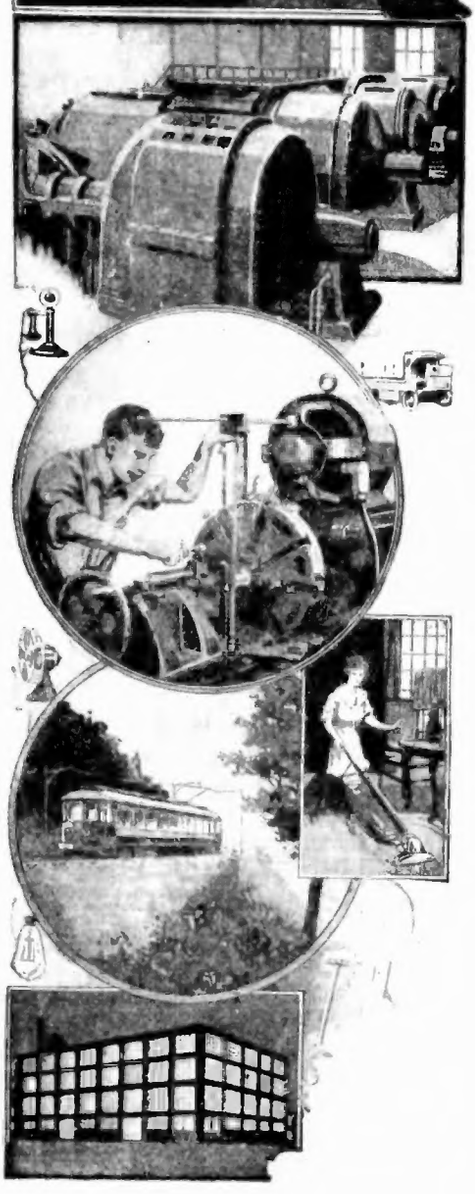

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H. GERNSBACK, EDITOR AND PUBLISHER
H. WINFIELD SECOR, ASSOCIATE EDITOR
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"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact"—HUXLEY

Stored Energy

THERE is no form of energy that we use on earth that has not its origin in the sun. The sun is all dominant, furnishing all our energy. The coal which we are using is but stored up energy, which had its origin in the action of the sun millions of years ago. If it had not been for the sun, the forests which sank below the earth's surface, there to become carbonized and which furnish us our coal would not be in existence now. The waterfall which furnishes us with hydroelectric power is but stored up solar energy. If it were not for the sun, no water would be vaporized and we would have no clouds from which the rain comes, and which in turn supplies the water for our rivers and our waterfalls.

As human progress and invention go on we become more and more dependent upon stored solar energy. We discover new sources of this transmuted energy every few years. Take for instance coal. Several hundred years ago, people were living on top of coal mines and were using coal for building purposes. They had not learned how to use the coal until someone accidentally noted that it burned after a wood fire had ignited it. Who knows but that the soil upon which we walk can be made to yield energy, if we only had the right key to unlock this energy?

There is today no means to utilize the solar heat as it comes to us. No solar heat generator has been found that is really practical and that will work for any length of time. It is true that we might store heat in vacuum chambers, thereby isolating the difference of temperatures, but this would be a very cumbersome and expensive process. Even then we might not get very far. We can store heat in water in a vacuum bottle and keep it somewhere near the boiling point anywhere from 24 to 36 hours, but that is about as far as we have advanced in storing heat.

It seems a much better way to store the energy indirectly. We have many methods for doing this. Take for instance the tides, another source of energy, which has its origin in the sun and moon. Many inventors have busied themselves devising tidal motors in order to utilize this energy. It is likely that there will never be developed a good tidal engine, and a much better way which is now being employed and which, used by our ancestors in tidal mills, is again acquiring new importance is the impounding of the ocean waters. Then after the tide has receded the waters are released, thereby driving turbines which in turn give us electrical energy to run our motors, our electric lights and which may store the electricity in storage batteries. This may seem to be a difficult and cumbersome method, but it is eminently practical, being in use now in England and in France. This impounding of the waters can be made use of in any locality where the difference between low tide and high tide is sufficient to make it worth while.

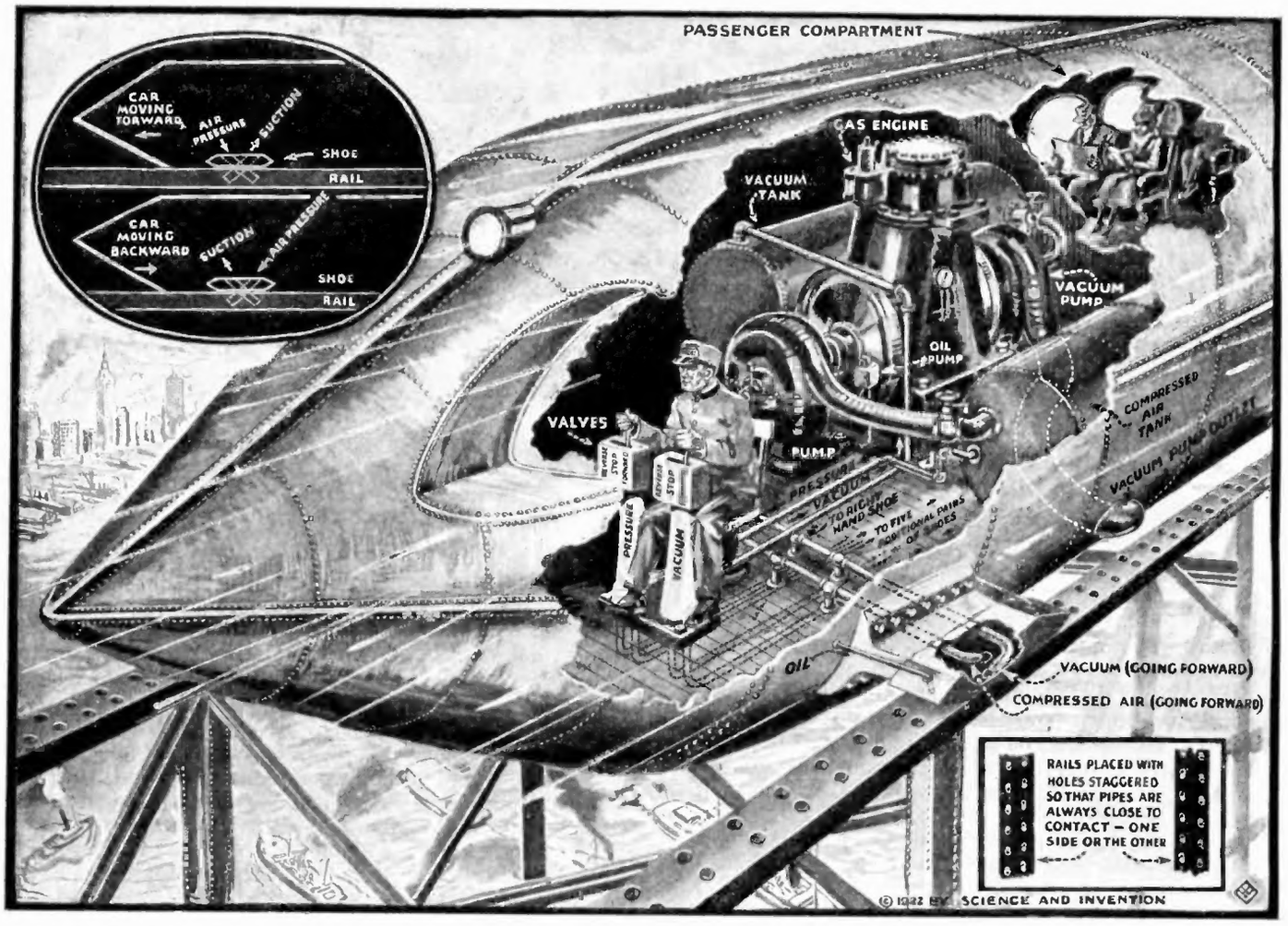
We need not speak here of the utilization of waterfalls which is being rapidly made use of all over the world. It would seem that during the next fifty years there would not be any waterfalls left, that could be tapped for their stored energy.

We come now to another form of energy; namely, wind power. This form of energy, which is tremendous, has hardly been touched. It is true that we have a few wind mills or wind motors, but we have not even begun to scratch the surface. There are tremendous possibilities in wind power which as yet lie dormant. We will never get very far if we try to utilize the wind directly, as for instance, by driving a dynamo and in turn charging a storage battery. This is a very wasteful method of exploiting the wind, just as expensive and futile as are the tidal motors. A much better way was described not so long ago by the writer where the wind power is used not to run dynamos, but to use the energy to impound water in large reservoirs. In this manner the wind motors or the wind mills can be run day and night pumping water from a low to a high level. At any time that the energy is required all we need to do is to let out the water from the reservoir which in turn will run our turbines. Naturally, if the reservoirs are very large, some means must be found to prevent the evaporation, as for instance covering the tanks or reservoirs. Thus we see that we translate wind power first into water power, and thence into electrical power. This is much better than storing up the current in storage batteries for the reason that the latter is not at all efficient and it also does not store electrical energy, but rather chemical energy.

There are still other kinds of stored energy, as for instance that contained in explosives. We are today already making use of the gasoline engine which is an explosion engine. The heat stored up in gasoline is here made to give up its energy. If we could utilize dynamite or nitro-glycerin, both fairly cheap —and there are others that are cheaper—we would have an ideal fuel. The reason, of course, is that pound for pound, dynamite and other explosives as compared to coal and gasoline are vastly more powerful. Thus, for instance, the energy contained in a pound of dynamite, if we could release it gradually, could propel an automobile for over 100 miles. Unfortunately, we have not reached the point as yet where we could utilize high explosives in such a way where the stored up energy can be released gradually instead of almost instantaneously.

There is no question, however, that the time will come when it will be possible for us to carry 50 horse-powers in a watch. Dynamite, nitro-glycerin and other high explosives if manufactured in large quantities can be sold cheaper than gasoline is today. So far, however, no means have been found to handle these explosives, but the inventor who solves this problem will certainly be one of the benefactors of humanity. This invention when it does come will revolutionize all our present modes of travel. It is certain that an automobile using a dynamite motor would not weigh more than one-quarter of the present ones. It is a problem worthy of the thoughts of our best inventors.

H. GERNSBACK.



This Latest Idea in Railway Propulsion Systems Operates on the Principle of Compressed Air Jets, Which, Emerging from Shoes on the Sides of the Car Against Openings in the Tracks, Tend to Push the Car Forward. The Locomotion Action or Propulsion of the Car is Aided Also by the Vacuum Pipes Leading Down Thru the Shoes, and These Vacuum Pipes Also Cause Any Oil or Water Lying in the Track Pockets to be Removed Therefrom. Power for Driving the Air Compressor to Charge the Tanks on Board the Train is Derived from a Third Rail or Else from a Trolley. To Reverse the Motion of the Car or Train, Compressed Air is Passed Thru the Pipes Pointing Forward, While the Vacuum is Caused to Act Thru the Rearwardly Facing Pipes, as the Detail Drawing Shows Clearly.

Compressed Air and Vacuum Railway

RAILWAY engineers have frequently voiced the opinion that it really is remarkable how tied down we are, apparently, to the use of rolling wheels for cars of every description, no matter whether they are steam, electric, or gasoline engine propelled. A few months ago there was described in this journal, a scheme proposed by an English engineer for running subway or other cars on ice-coated rails, the rails being hollow and having freezing brine pumped thru them, so as to cause the rails to take on a coat of ice, the same as the refrigerating machine pipes we frequently see in ice plants. A second scheme described in the same article was one employing smooth cylindrical tracks, over which the cars were to run on grooved runners or shoes, a sufficient quantity of oil being kept on the rails or else fed thru the car shoes. Now comes a third scheme for operating railway cars without wheels, and which operates with simple and well-tried apparatus, viz., compressed air and a vacuum, produced by machinery well-known to engineers today.

In a recent patent granted to Mr. Frank George Trask of North Dakota, he shows some clever ideas for a wheel-less railway train and the principal features of his invention are illustrated in the accompanying picture and drawings.

Briefly, his scheme for propelling the wheel-less car or cars along the rails, is to shoot compressed air at high pressure out of a series of shoes in a backward direction, down into a series of angular pockets in the rails, the reaction from this compressed air causing the car or train to move forward. The necessary compressed air is stored in a tank carried in the locomotive of the train, by means of an air compressor driven by a gasoline engine. The air compressor might also be driven by an electric motor, obtaining current for its operation thru a third rail, as desired.

The same motor or engine drives a vacuum pump, which maintains a certain degree of exhaustion in the vacuum tank; both this tank and that containing the compressed air under high pressure, are piped to control valves arranged in the manner illustrated.

When the motorman or engineer throws the valve levers so as to direct compressed air thru the pipes in the shoes, so as to shoot the stream of air rearward, the car moves forward; at the same time the levers open the valves, so as to connect the vacuum tank with the opposite holes in the shoes pointing forward, and this serves to remove oil or water from the track recesses.

Possibly many of us have seen the compressed air locomotives used extensively in mining work, and these have a range of several hundred miles on one charge of compressed air, the locomotive containing a series of large steel tanks in which the air is stored at high pressure. This provides another way of operating the Trask compressed air railway, sufficient air being stored in tanks in the locomotive for an average run, and, as he points out in his patent, it is possible for the compressed air tanks on the engine to be replenished from a supply station or tank along the route. Of course, the train would have to come to a stop in order to recharge the tank, it hardly being feasible to replenish the air supply while the car is in motion, as water is picked up from long troughs on the large steam railway systems today.

To reverse the train is a simple operation, it only being necessary to reverse the valve levers and direct the compressed air into the forward-pointing holes in the rail shoes, and connect the vacuum tank lines to the rearward-pointing holes in the shoes. When this is done, the train will move backward.

To those who have never experimented very much with compressed air as used in modern foundries and other plants at a pressure of 150 to 180 lbs. or more, such a railway may not seem very practical or feasible. However, it is surprising what a tremendous power compressed air will exert under a compression of 180 to 200 lbs. or more. We have never seen the action of air under a pressure of 300 or 400 lbs., but can imagine pretty clearly that a very surprising result will be obtained by its use, after having seen the results obtained with 150 and 180 lbs. air pressures.

Rivetting hammers and stone-cutting drills are good examples of some of the work that is being done daily by compressed air at such pressures, and this gives a practical idea as to the energy stored up in air under pressure. The inventor points out in his claims, that a forward propulsion of the car or train is aided and abetted to some extent by the vacuum or air exhaustion thru the shoe ports.

Forgery-Proof Checks

By BURGESS SMITH

FORMERLY OF U. S. GOVERNMENT BUREAU OF ENGRAVING AND PRINTING, WASHINGTON, D. C.

THE safety paper on which our bank notes, checks, bonds, wills, bills of sale, trade acceptances and other documentary securities are printed is the product of centuries of painstaking evolution in paper manufacture. Fraught with innumerable difficulties, this evolution has been very gradual, and there have been many critical stages in the process, when, due to the successful activities of forgers and counterfeiters, it seemed that use of bank notes and checks as a medium of exchange would have to be discontinued.

From time to time the press of the country gives warning that some new counterfeit notes are in circulation. The notes are described in detail and any signs by which the bogus paper may be detected are recorded. It was only a few days ago that the newspapers announced that counterfeit two-dollar bank notes, as well as bad checks, were being passed around.

In the Government Bureau of Engraving and Printing at Washington, where all Government paper of monetary value, except postal cards, is printed, every possible precaution is taken to ensure absolute protection of our documentary paper against thieves or counterfeiters. Every time the employees go in or out of the Bureau they are checked up, and the collusion of several of them would be necessary to get away with the dies or molds or the money itself.

In spite of the precautions taken by the Bureau officials, as well as by manufacturers of other documentary paper, the losses from counterfeiting and forgery have steadily increased. Of the 779 arrests made by the United States Secret Service in 1920, as compared with 510 in 1919, 645, or over three-fourths of the total number, were for the three offenses of counterfeiting notes, counterfeiting coins and passing forged obligations. During this period 121 molds, 70 plates and seven dies were seized.

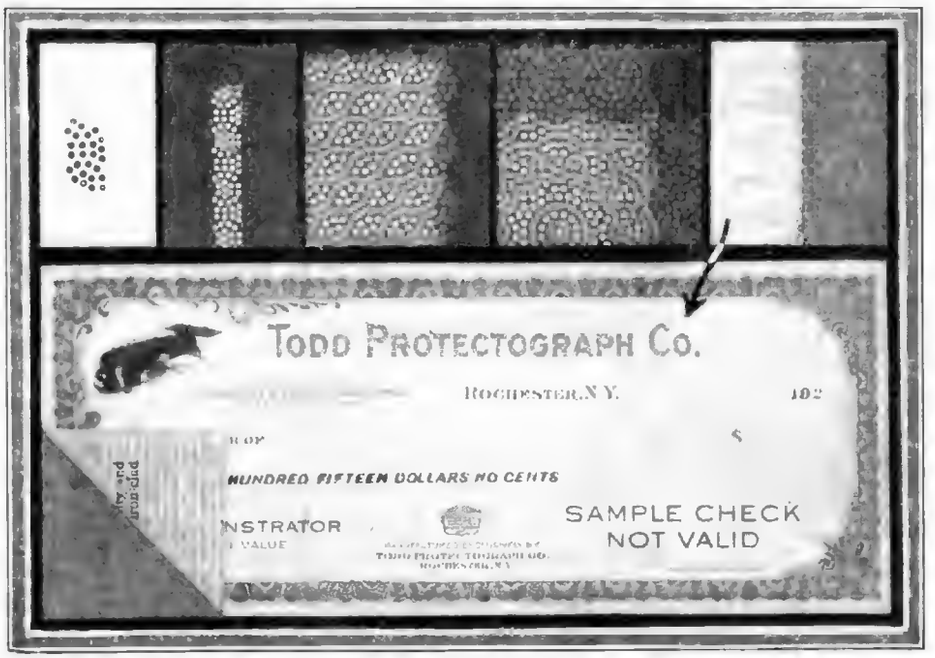
Due to the rapidly expanding credit facilities of the nation, losses from forged security papers have increased by leaps and bounds within recent years. The losses from forged and raised checks alone have now passed the amazing total of $35,000,000 annually. The explanation is found in the fact that 95% of the bank transactions of this country are now carried on through the use of checks, while the ratio of checks to actual currency in circulation is 100 to 1.

As compared to other forms of crime, forgery has been for many years on the increase. From a numerical standpoint, it is probably exceeded only by larceny, and in the huge losses entailed it is probably surpassed only by embezzlement or swindling. Large as the present figures are, they would undoubtedly be more astounding in the case of check losses but for the mitigating use of such preventives as check-writing machines and safety paper.

When checks first came into popular use in the United States they furnished a most fertile field for forgers and penmen. These crooks soon discovered that with a few strokes of the pen or the use of acids it was a comparatively easy matter to raise a check to almost any amount the signature would stand for. Take, for instance, four, five or six and see how easy it is to raise these numerical words tenfold by the careful tracing of a pen; and then we have forty, fifty and sixty, respectively. At that time the writing on any check paper could be erased with certain acids.

So it was but natural that the most cunning and skilled criminals should be attracted to such an open and easy field for crime; and there grew up in the United States between 1860 and 1900 numerous well organized gangs of forgers, who, living in secluded places, took checks that their agents had stolen from the mails or secured through other devious means, raised them to many times their original amount and then usually got away with the booty when they were presented for payment.

The modern check paper is the outgrowth of centuries of experiment by paper manufacturers. In their laboratories they sat and toiled away year in and year out, experimenting with the manifold uses of inks and acids and chemicals and photography, ever hoping, ever expecting to develop some paper that would, when fortified by the use of check-writing machines, put a final stop to the ravages of cunning check manipulators. They finally succeeded, and it is only through the failure of check users to observe simple precautions that these crooks are now able to exact an annual toll of $35,000,000 through check frauds.



Raised Checks Annually Cause a Tremendous Loss in the Business World, and Chemists and Other Experts Have Worked for Years to Perfect a Bond and Check Paper Which Would Be Absolutely Forgery Proof. By Means of the Simple Dot Design Shown in the Upper Left Hand Figure, and Super-Imposing Upon This a Second Similar Design, Innumerable Patterns, Difficult, and, in Fact, Almost Impossible to Duplicate, are Formed, as the Pictures From Left to Right Show. The Word "Void" is Printed All Over the Check Paper, and When Super-Imposed by Two Different Dot Designs, Nothing But a Certain Pattern of Dots Can Be Discerned. If the Written Figure is Erased, the Pattern Cannot Be Duplicated, and If Ink Removing Acids Are Applied, the Dot Designs Dissolve, Leaving the Word "Void" Wherever the Acid Has Been Applied. The Back of the Check is Treated to a Similar Triple Forgery-Proof Impression or Design. By Looking Closely at the Specimen Check Above, One Will Note the Word "Void" Spread All Over It, Due to Acid Having Been Applied to the Surface.

Checks printed on this paper defy the forger's erasing and bleaching acids. If he tries to obliterate the payee's name, date, number or figures, immediately something very peculiar takes place. The tinted surface pattern of the paper instantly dissolves and out flashes a canceling word, "VOID," which is repeated 1,200 times all over the surface of the standard sized check. Before the check is dipped into the acid solution the word "VOID" is not perceptible to the naked eye, and its presence is never known until alteration is attempted. But once this warning word, the danger signal, springs magic-like into view, it cannot be removed and the surface of the paper cannot be restored.

The process used by the manufacturers of the best safety paper for checks and other documentary securities is practically the same as that employed in making bank notes in our Government Bureau of Engraving and Printing. And in view of its very recent development, a somewhat detailed description of the process seems fitting. In this instance, I shall describe the process used by the Todd Protectograph Company of Rochester, N. Y., which has developed a new safety paper called Protod-Greenbac, that has been on the market only a short time.

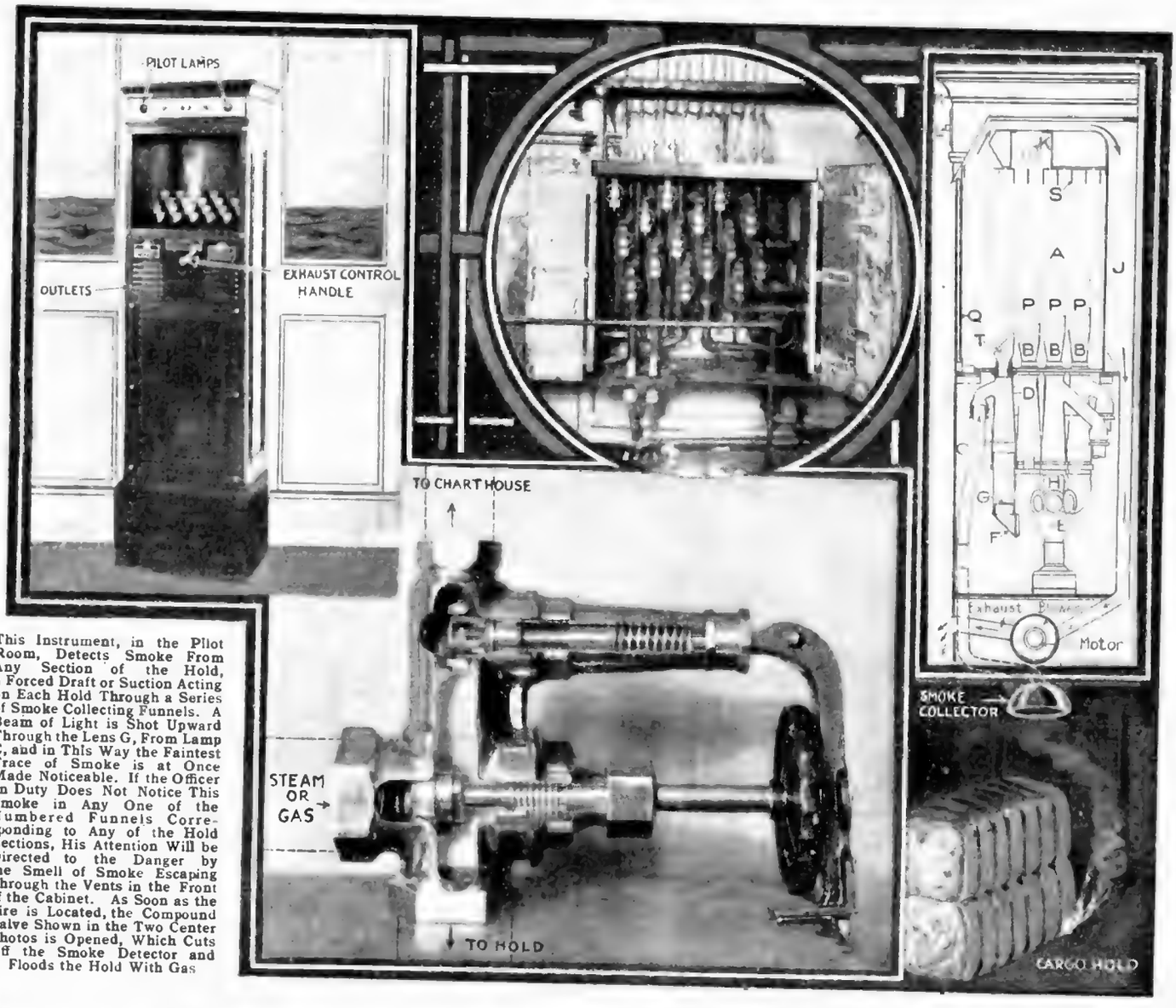
The first step is to draw on a card a cluster of tiny circles, which are photographed down on a plate glass until they are reduced to mere dots. Then another cluster is drawn and is likewise reduced to pinpoint size on another glass plate. Apparently there is no special design in the manner in which the circles are grouped. In truth there is and the mathematical formula containing the secret is carefully guarded under lock and key, just as such patterns in the Bureau of Engraving and Printing at Washington are zealously protected by the Government.

The two negatives thus obtained are next taken each in turn into a dark room and placed in the steel chamber of a large electrically controlled camera, which is bolted to solid masonry to prevent the slightest vibration. The only semblance of light in this room is the red glow from a shaded bulb of jack o'lantern effect. Even this is extinguished as soon as operations begin.

In this semi-darkness the huge camera looms up like a giant telescope. It weighs several tons and is equipped with its own set of micrometer gauges that bring the image to a determined point on a plate with the nth degree of precision.

Over in one corner of the room is a small cylinder-shaped machine, about two feet in height, which is an important timing device to be used in the operation. It stands on a masonry bed apart from the machine, as does the motor, so as to eliminate all vibration.

(*Continued on page* 400)



This Instrument, in the Pilot Room, Detects Smoke From Any Section of the Hold, a Forced Draft or Suction Acting on Each Hold Through a Series of Smoke Collecting Funnels. A Beam of Light is Shot Upward Through the Lens G, From Lamp E, and in This Way the Faintest Trace of Smoke is at Once Made Noticeable. If the Officer on Duty Does Not Notice This Smoke in Any One of the Numbered Funnels Corresponding to Any of the Hold Sections, His Attention Will be Directed to the Danger by the Smell of Smoke Escaping Through the Vents in the Front of the Cabinet. As Soon as the Fire is Located, the Compound Valve Shown in the Two Center Photos is Opened, Which Cuts Off the Smoke Detector and Floods the Hold With Gas

Ship Fire Detector and Extinguisher

By ROBERT G. SKERRETT

SHIPS are now built, equipped, and handled in a way that tends to minimize nautical perils. But, despite these improvements, the casualties due to fire are, generally speaking, on the increase. Nothing fills the seafarer with more dread than the fear that flames may break out somewhere within the body of his craft. Statistics show that the packed holds of ships are the most fruitful sources of conflagrations. For instance, in the course of only six years maritime records the world over have listed 835 fires. Of these 65 per cent. originated below decks; and of the below-deck fires fully 72 per cent. started in the cargo spaces! Just think for a moment what this menace means.

Cargo fires may be due to various causes. Cotton bales are a frequent source of trouble: they will carry a chance spark dropped in at the cotton gin, and when lowered into the hold of a vessel the dangerous bale will give no outward sign of the peril lurking deep within. Inflammable vapors given off by chemically changing materials are often responsible for maritime fires; so, too, is the oxidation of coal, in bulk; and it is a matter of unhappy but common knowledge among the nautical fraternity that friction set up in shifting cargo will produce heat and then flame. The rolling and pitching of a craft in stormy weather may, therefore, start a conflagration unless the freight is packed so tight that there is no chance of movement.

Fortunately, human cunning has at last solved this serious problem in a strikingly ingenious way; and something like half a hundred steamers, including the giant new liner *Majestic*, are so safeguarded. The installation, known to the shipping world as the *Rich system*, is capable of discharging the double duty of detecting and of extinguishing fires on shipboard occurring below decks. It is designed to supplement fire-fighting facilities already prescribed by our revised statutes. That is to say, it makes use of the steam lines which are now led, in compliance with the law, to cargo holds, bunkers, and other closed compartments for smothering menacing flames.

These steam pipes radiate to all parts of a vessel, and their function is to enable the mariner, when he discovers and locates a fire in his craft, to feed steam directly from the boiler into the endangered compartment for the purpose of suppressing the conflagration. It will be noticed that this piping is intended for a one-way service. The Rich system, on the other hand, provides a two-way service without radically modifying the steam-smothering line. Let us explain.

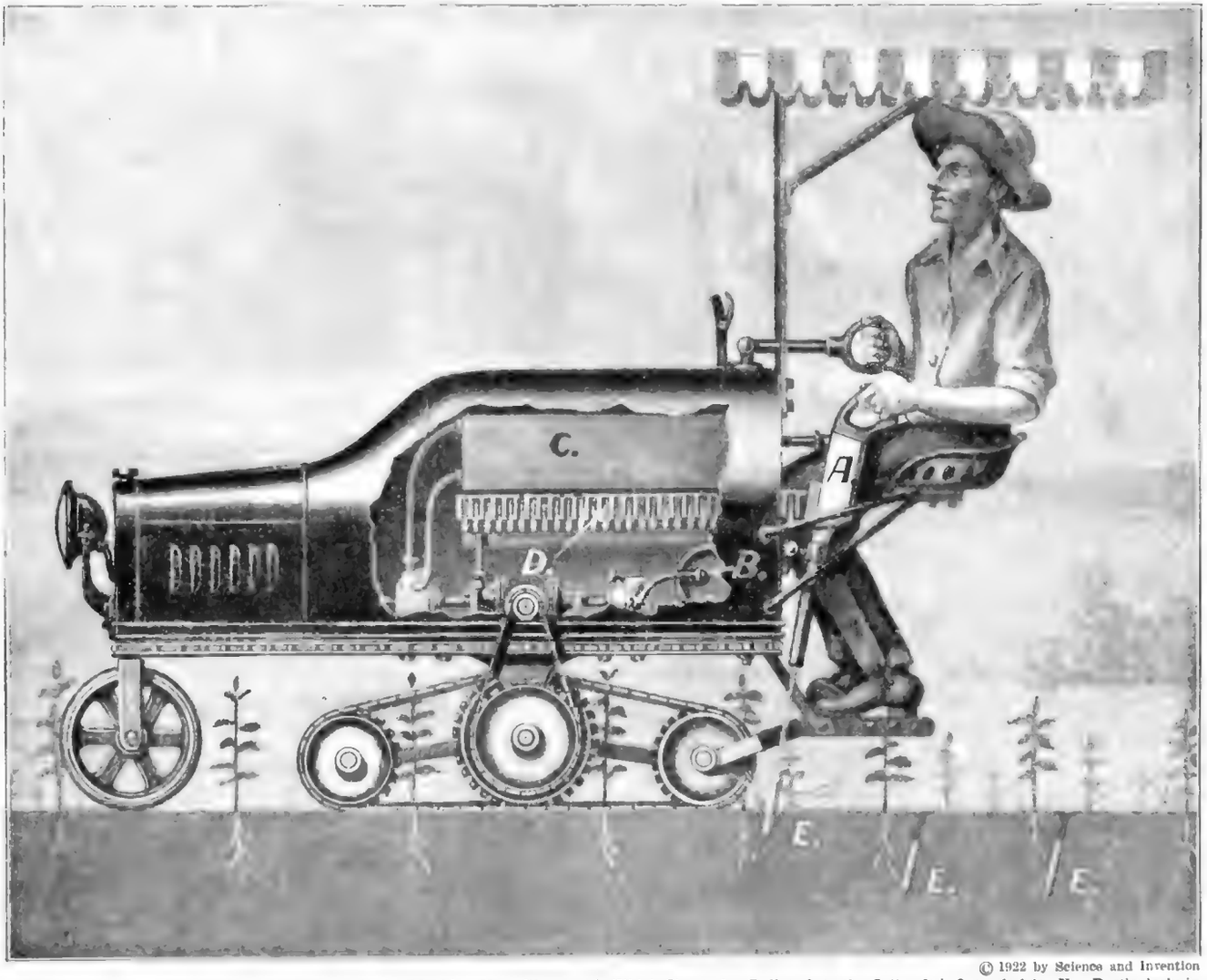
At the hold terminals of the piping are attached bell-shaped mouths, covered with wire netting, and these are known as *smoke collectors*. According to the size of the compartment, there are one or more of these mushroom-like intakes. At suitable points—usually two on a large vessel—the steam smothering lines come to a focus in valve-control cabinets. One cabinet is for the forward subdivisions and the other for the after-holds of the craft. Normally, the valves are set so that the entire system is open between the smoke collectors and a third cabinet, *the detector*, placed in the chart house, where somebody is always on duty. This latter cabinet is linked with the two valve cabinets by flexible conduits, such as are used for the housing of electric wires in buildings. Every valve in each valve-control cabinet has its particular outlet in the detecting cabinet.

The detecting cabinet is unique, and its details may best be understood by reference to the accompanying cross-section. Briefly, an electrically-driven exhaust fan, which operates continually, tends to exhaust the sealed chamber, A, wherein terminate the connections with the divers compartments. Each exhaust pipe carries a flare, B, which is duly lettered to indicate the cargo hold, bunker, etc., with which it is associated. The suction of the blower causes currents of air to

(*Continued on page* 380)

Firing Ice Bullets into Soil

By MARK TAYLOR



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The Latest Idea in Agricultural Developments is the Machine Here Illustrated, Which Shoots Ice Bullets Into the Soil. It is Intended for Use Particularly in Dry Parts of the Country, and Its Inventor and Patentee Believes That It Will Prove More Economical in Every Way Than the System of Irrigating Land by Ditches and Wells, Etc. The Ice Bullets E, When Shot Into the Ground From the Compressed Air Gun A, by the Operator, Melt and Thus Water the Roots of the Plants in an Economical and Efficient Manner. C Represents the Refrigerating Machine Driven by the Tractor Engine. The Ice Bullets as Delivered by the Refrigerating Machine, Are Carried Along on a Conveyor D, to the Pneumatic Gun A. B is a Compressed Air Tank.

MILLIONS of acres of land in the United States lie in regions where there is little or no rainfall. Much of this land is fertile and would offer splendid opportunities for agricultural development were it not for the great difficulty of obtaining an adequate supply of water for irrigation purposes. It is true that much has been accomplished already. Many square miles of desert land have been transformed into green fields and fine orchards by irrigation with water derived from supplies impounded far away in the mountains by great dams such as the Roosevelt Dam. Much water, however, is wasted.

In the usual method of irrigation the water is brought in canals from the source of supply to the locality where it is to be used. The water is distributed to the farmers in ditches called laterals. From these laterals the water is distributed over the land to be irrigated in a series of small trenches arranged in parallel fashion. The trouble with this method is that if the plants to be watered are arranged in rows the little trenches must run between the rows and the precious water is soaked up by the ground between the rows so that very little gets to the place where it is most needed, namely the plant roots. Much of the water is lost by evaporation owing to the hot sun and dry wind.

Mr. Elton F. Reid, an ingenious inventor of Waco, Texas, has recently patented a method which he claims will remedy these defects in the present methods of irrigation. He intends to supply the water directly to the roots of the plants in a manner which will prevent loss due to evaporation, and this he accomplishes by manufacturing the water into ice projectiles which are fired into the ground in close proximity to the plant roots. The soil closes over the ice bullets and they soon melt and supply water directly to the roots without waste.

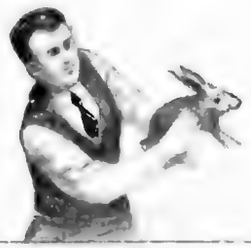
To carry his improved method of irrigation into effect Mr. Reid has designed a machine somewhat similar to the one shown in the accompanying sketch. It consists of a self-propelled vehicle which can be steered to travel along the plant rows. The machine carries a small refrigerating plant which freezes water into the form of ice bullets in split molds which open up and drop the projectiles on to a conveyor which carries them in a continuous stream to a compressed air gun located near the driver's seat. A suitable air compressor is provided to supply the gun with compressed air. The same source of power which propels the machine serves to supply power for operating the refrigerating plant and the air compressor.

In operation the driver steers the machine down the plant rows and as it passes each plant he fires an ice bullet into the ground near the plant where it soon melts and waters the roots. In this manner a most economical utilization of the water is secured. The inventor further contemplates the use of fertilizer in the irrigation water so that when the ice bullets melt the plants will be watered and the soil enriched at the same time.

Considering this new ice bullet irrigation machine from a scientific standpoint, we can only say that the inventor is apparently somewhat ahead of his time, like many other well meaning men of our day. There is no doubt that at a somewhat later date, a different method of producing ice quickly will be devised, than the one we now have, and then this process of irrigation will not seem so impractical. Some genius is going to come along one of these fine days and give our refrigerating engineers a jolt, which will make them rub their eyes with wonder—perhaps he will make ice directly by electricity. This method of producing cold has been touched upon before in this journal, and the phenomenon known as the *Peltier cross* effect, can be found in any good electrical text-book.

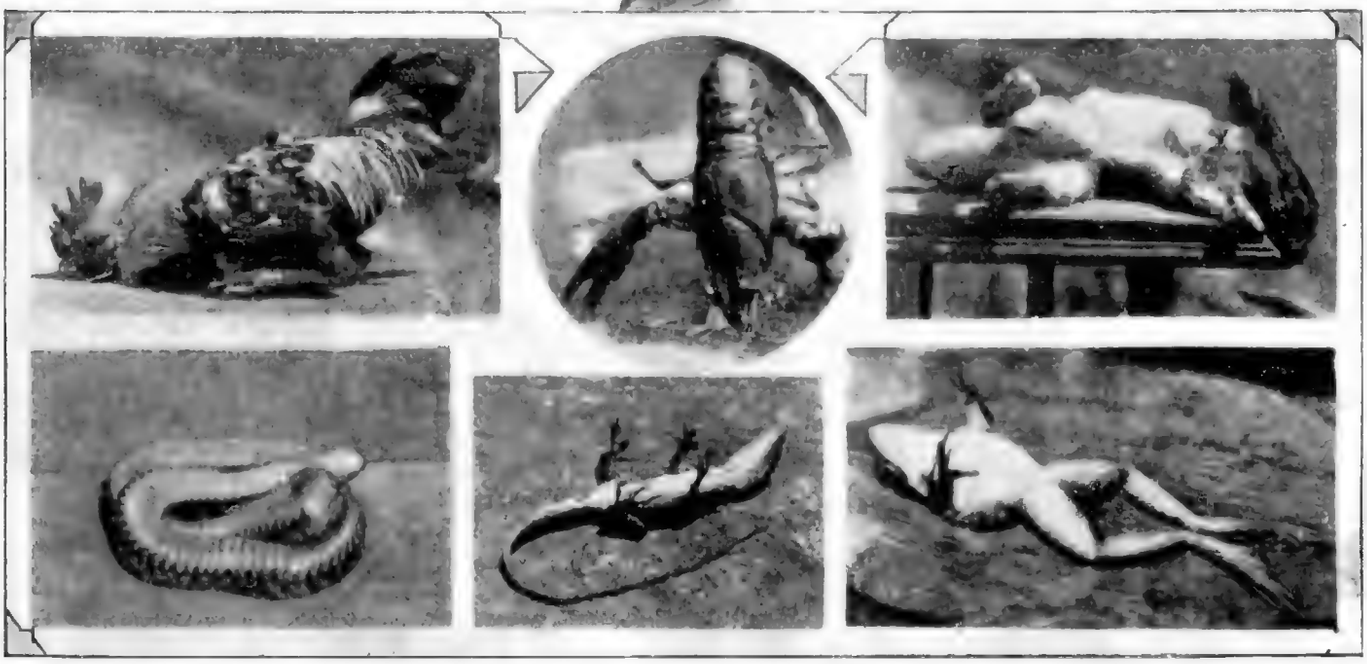
(A clever idea, but seemingly impractical due to high cost of this type of irrigation. —Editor.)

How I Hypnotize Animals



By C. SCHMITT

ACTUAL PHOTOS BY DR. E. BADE



The Accompanying Illustrations Show Some of the Most Interesting Hypnotic Tests. At the Top, the Method of Hypnotizing a Rabbit is Seen, Where the Rabbit is Rocked to and Fro; When Thrown with a Sudden Movement on its Back, the Head Sinks Back Inertly. In this Hypnotic State, the Animal Lies Perfectly Quiet on the Hand. The Other Pictures, Reproduced from Actual Photographs Taken by Dr. Bade, Show a Rooster Hypnotized; Next a Lobster; While the Upper Right-Hand Picture Shows Another Stage of a Rabbit Hypnotized; the Lower Left-Hand Picture is that of a Snake Hypnotized and Lying on its Back; the Lower Central Photo Shows a Chameleon Hypnotized and Lying on its Back, While the Lower Right-Hand Photo Shows a Frog Hypnotized.

ANIMAL hypnotism is not at all related to man; in fact, it is nothing more than a paralysis of the muscles and has nothing to do with mental powers. True hypnosis is always based on an act of autosuggestion, but here it is the result of certain bodily stimuli of one sort or another producing immobility.

Photos taken from such hypnotized animals are always greeted with a smile; no one believes that they have been taken from living creatures. In certain cases, however, a slight obscurity in the details of leg or head were sufficient to show that the animal moved during the photographic exposure.

For those who doubt these experiments the following description will be of value. A young rabbit was held in the hollow of the hands and rocked to and fro. He resisted energetically, but, when thrown with a sudden movement on his back, the head sank back inertly. In this hypnotic state, the animal lay perfectly quiet on the hand. It was then put upon the table, but this could not be done without wakening the animal. The hypnotic effect vanished, the paralyzed muscles came back to life, and the head was lifted. The ears seemed particularly resistant to the hypnotic state. But when the animal was placed on the table so that the head projected over the edge, it first breathed quickly and excitedly, gradually grew tired, and, in

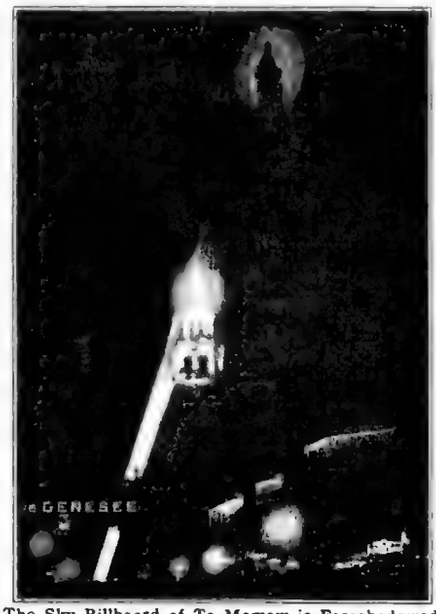
(*Continued on page* 396)

Sky Billboards of To-Morrow

THE night sky will be turned into a billboard, if several New York advertising companies succeed in their plan of communicating with the purchasing public in words and pictures projected upon the heavens.

Billion candle-power searchlights already have flooded clouds and layers of moisture with light to a height of ten miles above the earth, making pictures and fantastic figures in the sky which are said to have been seen a distance of 75 to 100 miles. The tower of a building was silhouetted against, a cloud over Buffalo, with the appearance of a gigantic black structure in the heavens. Words could easily be silhouetted on clouds in similar fashion, it is said.

"Since the New York *Times* told of the strange effects produced on the sky by the billion candle-power searchlight in use at Tompkinsville, N. Y., representatives of two advertising companies have inquired about the possibility of displaying advertising matter on the sky," said M. L. Patterson, chief searchlight engineer of the Sperry Gyroscope Company of Brooklyn. "We use the lights now for all sorts of signaling. There would be no objection to experimenting with the use of letters to block out part of the light and type words on the sky, but it would involve costly experiments."



The Sky Billboard of To-Morrow is Foreshadowed in the Picture Here Shown, Where a Sperry Search-Light Reflects the Image of a Tower on the Clouds.

The whole sky from Jacob's Ladder to Castor and Pollux, could be made to burn with invitations to the public to buy certain kinds of gum, suspenders and petticoats, or with petitions to vote for the people's friend for alderman, according to the engineer, if there were companies enough in the business and no law against it. The "majestical roof, fretted with golden fire" might look like the curtain of a second-class vaudeville house.

"At Buffalo, the light was trained at a high angle on the tower of the Edison Company building so that the tower intercepted a great part of the light," said Mr. Patterson. "The effect on a cloud was then photographed. I have the picture here now. The outlines of the building are clear and definite, making a perfect silhouette."

In answer to a suggestion made by one of the editors, Mr. Patterson said, "The suggestion which you made in regard to steam jets used as a background for advertisements from a searchlight, would I believe be possible, altho the steam in general would probably provide a very wavy screen on which to project distinctive figures or letters, especially if the light was very greatly above the jets. Steam jets have been used to make a projected searchlight beam more visible where the beam is used for attracting attention to a certain fixed advertisement board."

Science Tells Musically Talented

By A. H. KOLBE

THE realization of a system of scientific music training, which, it is claimed, will materially elevate musical standards, has many possibilities. Without any conjecture, however, the results now achieved—and the research is not nearly completed—indicate that it is going to affect vitally the national music and musicians.

There are four centers of music-psychology study in the United States and the psychologists have been working in a steady, sound manner, making innumerable tests to verify conclusions, and avoiding publicity. The foremost of these centers is the laboratory of Dr. Carl Seashore in the University of Iowa. Others are in San Francisco, Cal., Rochester, N. Y. and the laboratory of Dr. Max Schoen in the Department of Research, Carnegie Institute of Technology, Pittsburgh, Pa. It is on the experiments of Dr. Schoen that this article is based.

By putting musical education upon a sound scientific basis, psychologists propose to do away with inefficient teaching and save time, effort and money for the student. By a thoro examination of talent, using reliable and accurate instruments and charting the results, a teacher can tell unmistakably the weak and strong points of the pupil and mould the course of study accordingly. It means an education scientifically adapted to the particular needs of the individual.

The psychological examinations for talent are divided into five sections embracing the fundamentals of musical production. That is, musical sensitivity, action, memory and imagination, intellect and feeling. The sensitivity examination deals with the sense of pitch, intensity, time, extensity rhythm, timbre, consonance and volume. The action tests comprise the natural capacity for skill in accurate and expressive productions of tone in the control of pitch, intensity, time, rhythm, timbre and volume. Musical memory and imagination include auditory imagery, motor imagery, creative imagination, memory span and learning power. The intellect test comprises free association, power of reflection, and general intelligence. The feeling examination covers musical taste, emotional reaction and emotional self-expression.

With these standard tests it is possible to tell not only whether a person has music talent or not, but to determine what instrument should be studied. For example, since one's sense of pitch is basic, inherent and unchangeable, it is claimed that if your pitch discrimination is poor or very good when you are young, that same defect or gift will be with you when you grow old; a child with a poor pitch discrimination would most surely be discouraged from the violin or similar instrument, the tones of which he could not accurately determine. If the tests proved that the child had sufficient other qualities to warrant it, he could be diverted to the piano, where he would not have to worry so much with questions of pitch.

Dr. Seashore has been called "the leading music psychologist of the world and the greatest friend and benefactor of the musician, whose inventions for measuring musical talent and established standards are the only ones available." In Germany the study of music psychology lagged because of the absence of measuring instruments. Dr. Seashore has been studying music psychology for twenty-five years, but has only been recognized in the last few years. His *tonoscope*, which visibly registers tonal vibration, and which more than anything else has developed and will develop scientific musical education, was invented in 1901, and even to-day there is not more than a handful of them in all the world. Dr. Seashore's first important studies on the tonoscope were made in 1915, and in the last six years the instrument has been the basis of research.

The tonoscope is seen in one of the accompanying illustrations. It consists of a balanced drum, revolving precisely at the rate of one revolution per second. On the drum are black dots in the vertical plane rows. The row at the left of the drum contains 110 dots, representing 110 vibrations, and one dot or vibration is added to each row to the right and so on so that the last row to the right contains 219 dots. The number of dots in the row is marked on the scale to be seen in front of the instrument. As tone depends upon vibration and the vibrations per second of each tone is known, it is easy, by measuring vibrations, to determine whether or not the pitch is correct.

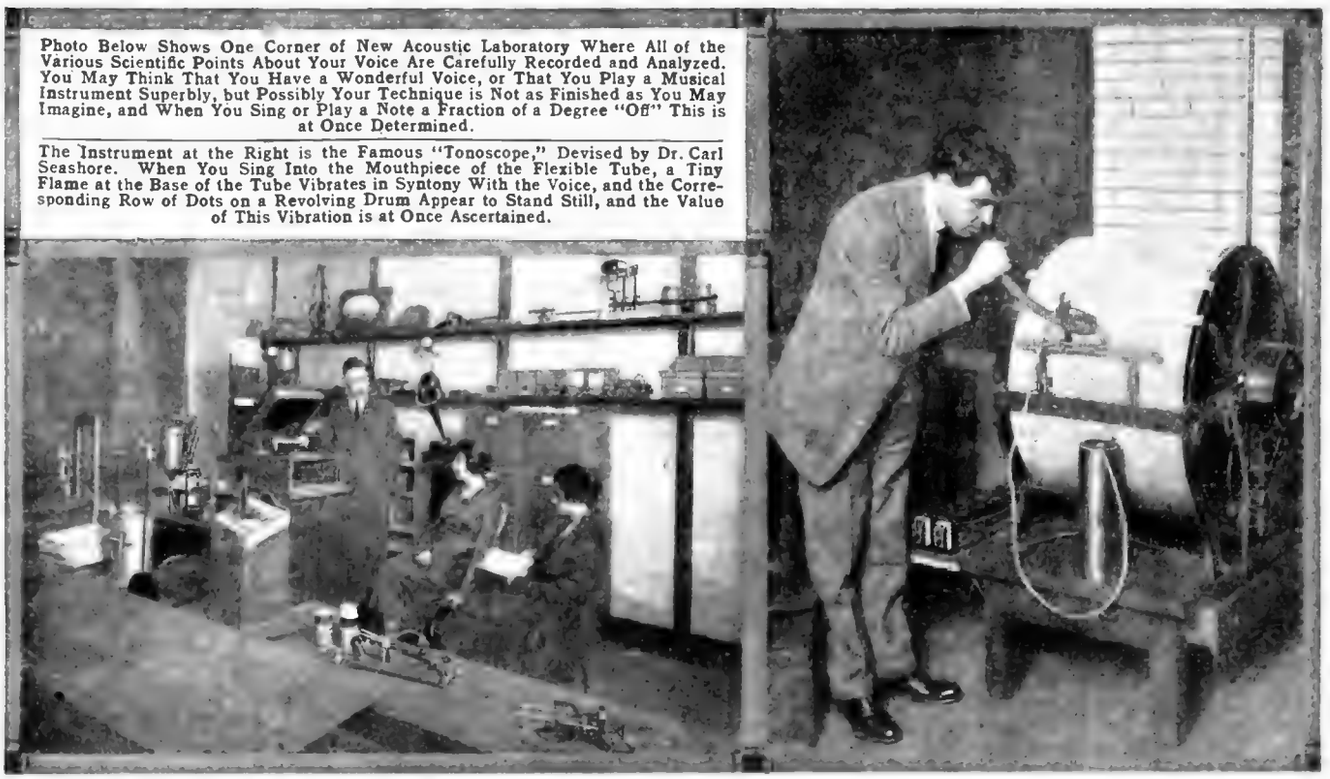


Photo Below Shows One Corner of New Acoustic Laboratory Where All of the Various Scientific Points About Your Voice Are Carefully Recorded and Analyzed. You May Think That You Have a Wonderful Voice, or That You Play a Musical Instrument Superbly, but Possibly Your Technique is Not as Finished as You May Imagine, and When You Sing or Play a Note a Fraction of a Degree "Off" This is at Once Determined.

The Instrument at the Right is the Famous "Tonoscope," Devised by Dr. Carl Seashore. When You Sing Into the Mouthpiece of the Flexible Tube, a Tiny Flame at the Base of the Tube Vibrates in Syntony With the Voice, and the Corresponding Row of Dots on a Revolving Drum Appear to Stand Still, and the Value of This Vibration is at Once Ascertained.

The tone, produced by voice or instrument, enters the cylinder thru a speaking tube. The vibrations strike a sensitive rubber drum which vibrates correspondingly, which, in turn, acts upon the gas feeding a tiny flame before the dots. Thus the flame vibrates just as many times per second as the tone, and produces a visual phenomenon upon the revolving drum of dots. The row having in it the same number of dots as the vibrations of the flame appears to stand still, while other rows in its vicinity, also slightly affected by the vibrations, revolve around it to the left. If you are singing into the instrument and you *slide up to your note*, it is easily seen. If you sing even so little as one vibration off pitch, that fact also stares you in the face

Another of Dr. Seashore's novel instruments is the *audiometer*, which, by means of an electrically produced sound, variable in intensity, can accurately test an ear for pitch and range varying from 11,000 to 20,000 vibrations per second. So excellent is this instrument that it

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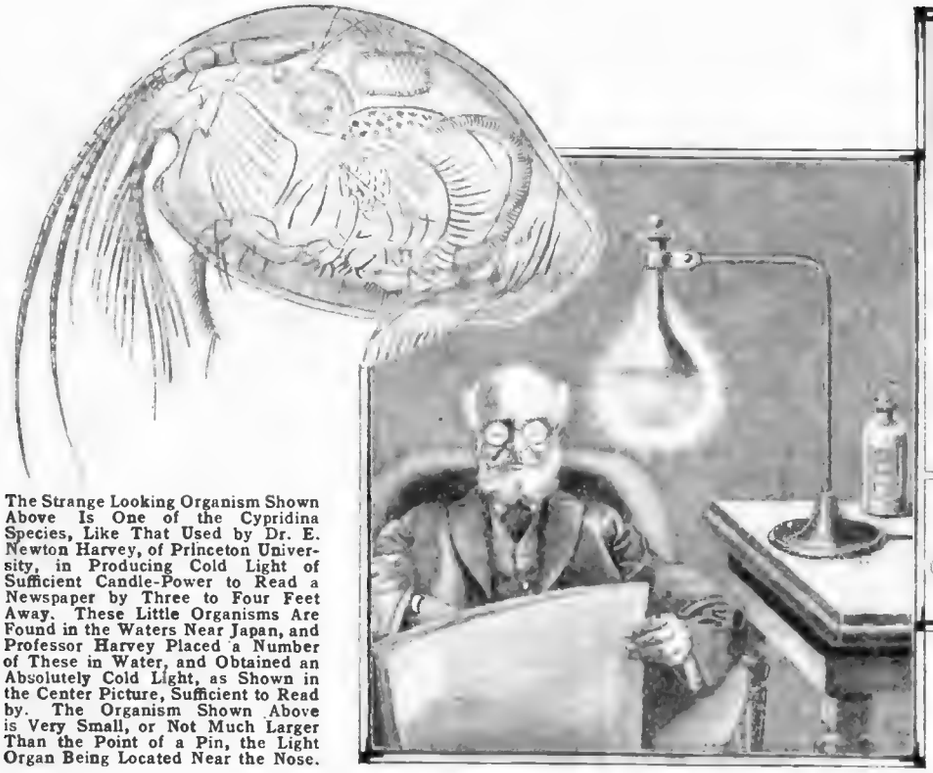

The Strange Looking Organism Shown Above Is One of the Cypridina Species, Like That Used by Dr. E. Newton Harvey, of Princeton University, in Producing Cold Light of Sufficient Candle-Power to Read a Newspaper by Three to Four Feet Away. These Little Organisms Are Found in the Waters Near Japan, and Professor Harvey Placed a Number of These in Water, and Obtained an Absolutely Cold Light, as Shown in the Center Picture, Sufficient to Read by. The Organism Shown Above is Very Small, or Not Much Larger Than the Point of a Pin, the Light Organ Being Located Near the Nose.

Fig. A Above Shows a Sectional View of the Luminous Gland of the Cypridina Hilgendorfii. Fig. 1 Shows a Longitudinal View of the Light-Giving Gland, and Fig. 2 Shows a Transverse Section. Fig. B Below Shows a Single Enlarged Gland Cell of Cypridina. P, Nucleus and Plasmasome; C, Cytoplasm; F, Secretion Fibrils; D, Reservoir Duct; O, Valve-Like Outer Opening at Surface of Body.

Cold Light

By Dr. ERNEST BADE

IT was not so long ago that the phenomenon of the phosphoric sea was believed to be based upon the presence of phosphorus. Others thought that the salts of the sea produced, locally, spontaneous combustion, while still others were of the opinion that the ocean's glow depended upon electricity or friction. But such conclusions were all baseless. Now it is known that this wonderful sight is produced by tiny living organisms of vegetable or animal origin.

That tiny, minute, almost infinitesimal organic being, which is carried hither and thither by current and counter current, which rises and falls, a plaything of the heaving waters, is plankton. Since the phosphorescent sea is produced by many different plant and animal groups, and since each of these occur at different times, it is but natural that the sight of the glowing ocean differs at various seasons and in different places The most common of these plankton organisms producing their own light are *Bacteria, Radiolaria, Dinoflagellata, Crustacea;* larger luminous marine forms are jellyfish, worms, mollusks and tunicates.

Many marine animals play their part near the surface of the water during the day, at night they disappear, their place being taken by others. Those that have played and chased about the sunlit waters sink back to the obscuring dusk at night, while those that have lived in the semi-obscurity of the depth during the day rise to the surface at night. Many of these nocturnal creatures which rise to the surface are luminous.

The production of light is most varied and the intensity of the light differs with the species. Then, too, the ability of producing phosphorescence may be diffused throughout the entire body, or it may be restricted to certain definite regions as light organs. In some animals but one or two parts of its body are specialized to give off light; others have many more, and then they are usually arranged geometrically in the most varied of patterns, each individual species having its own distinct system.

The most fantastically formed creatures which are able to produce light belong to the class of *Crustacea*, and the most beautiful examples of luminescence are found among the *Ostracods*. It is the Japanese *Cypridina hilgendorfii*, a tiny creature producing a strong blue light, that was used by Dr. E. Newton Harvey of Princeton University in many of his experiments on the nature of cold light. Dried specimens were used and, by various processes, *Luciferase*, highly specific in activity, was isolated. It was found in the luminous organs, not in the non luminous parts, and not in non-luminous species of closely related *Cypridina*. This substance, according to Dr. E. Newton Harvey, is an oxidizer; in action it is like a catalyst and in nature probably an enzyme.

The substance that is oxidized is *luciferin*, which is found not only in the luminous organ, but probably in the non-luminous parts as well. This process not only produces light, but also converts it into *oxyluciferin*. This change is accomplished by means of the enzyme *luciferase*, and it involves no fundamental destruction of the molecule as it is a reversible process. The reduction of *oxyluciferin*, with various chemicals, was also accomplished in the laboratory so that the oxidation of *luciferin* with luminescence, its change to *oxyluciferin* and its reduction to *luciferin* again is possible *in the laboratory*.

Dr. E. Newton Harvey produced his blue light by means of a solution of *luciferin*, to

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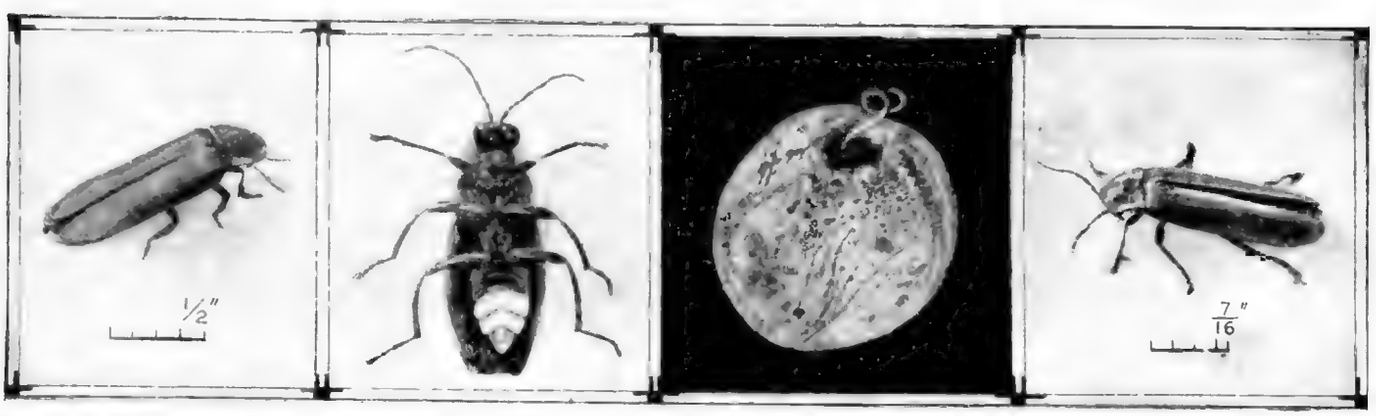
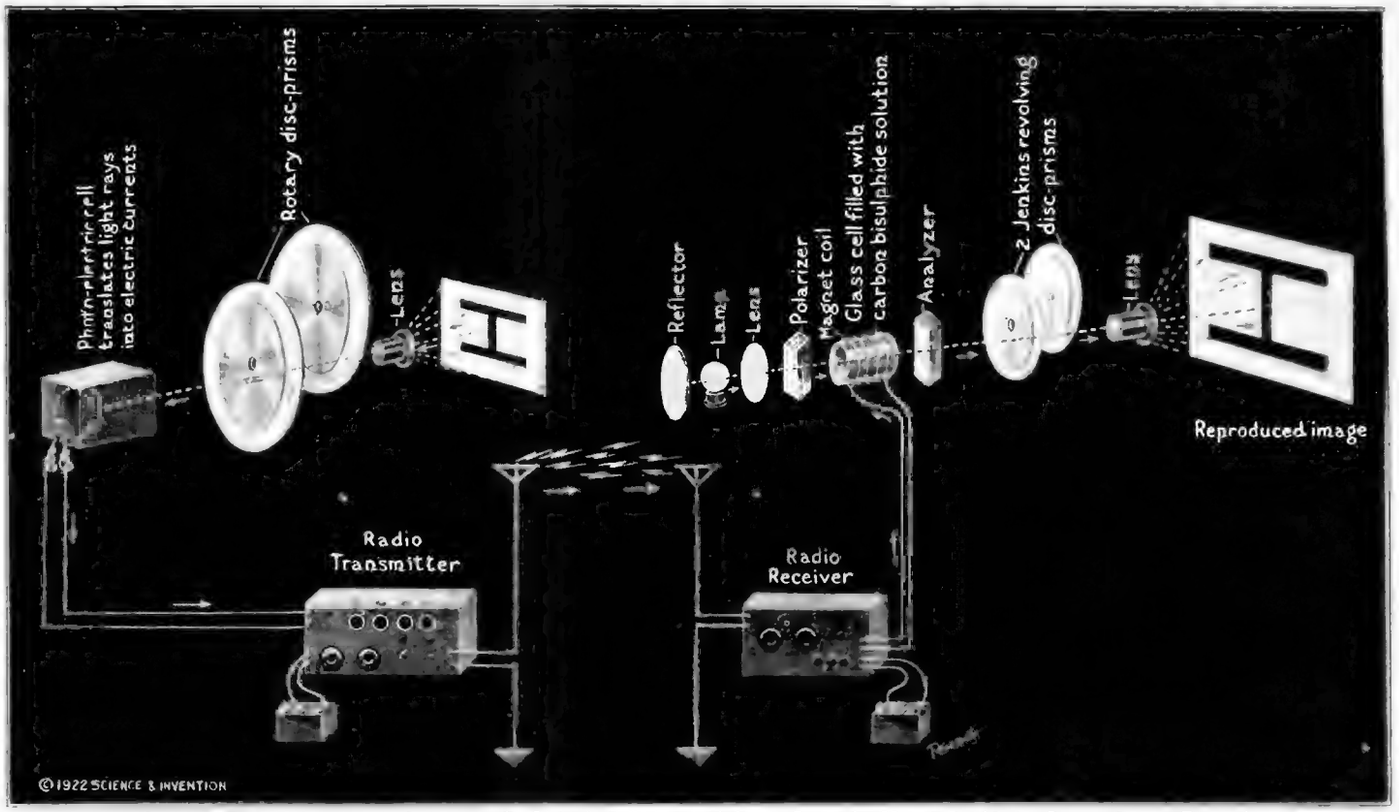


Photo at Extreme Left Shows One of Nature's "Cold Light" Experts, the European Lightning Bug; the Next Photo Shows an Under View of an American Lightning Bug, the Light Organ Appearing in White Near the Tail; the Third Photo From the Left Shows the Noctiluca Miliaris, Which Gives Forth a Beautiful Green Light When in the Water. The Photo at the Extreme Right is Another Form of Native Lightning Bug.



The Apparatus Used by Mr. C. F. Jenkins of Washington, D. C., in Actually Transmitting an Image by Means of a Motion Picture Camera Transmitter and a Radio Receiver, Coupled to a Special Projector Mechanism, is Here Shown in Diagram Form, So as to Be Easily Understood. The Image of the Letter H at the Transmitter (at left), Which May Be Moving or Stationary, is Flashed Through the Lens and Two Revolving Disc Prisms onto a Photo-Electric Cell. This Cell Changes Its Resistance in Proportion to the Amount of Light Falling on it, and Consequently Various Light and Shade Values Cause Corresponding Fluctuations in the Transmitted Radio Current. These Pulsating Electric Waves Are Picked Up by a Radio Receiving Set in the Usual Manner, and the Amplified Current Pulsations, Corresponding to the Light and Shade Values of the Transmitted Image, Pass Around a Coil Inside of Which is a Glass Cell Filled with a Carbon Bisulphide Solution. Certain Polarizing Effects Set Up in the Optical System of Lenses and Prisms, as Well as the Carbon Bisulphide Cell and the Magnet Coil, Together with Two More Revolving Disc Prisms, Cause a Duplicate of the Original Image to be Flashed on the Screen.

Movies Sent Via Radio

By S. R. WINTERS

Pictures Actually Transmitted by C. F. Jenkins Inventor of Movies

THIS arresting title when seriously employed by any individual other than the accredited originator and inventor of the motion-picture machine would smack of sensationalism and the claim would be considered visionary. However, when C. Francis Jenkins of Washington, D. C., possessor of the Elliott Cresson gold medal, awarded by the Franklin Institute of America for his original contribution to motion-picture mechanics, announces that he has discovered a means for transmitting photographs and motion pictures through space the public lends an attentive ear. The revolutionary character of the discovery, however, gives cause for doubt in the popular mind as to the success of the enterprise, irrespective of the prestige of the inventor.

With this introductory paragraph, not in the form of an apology, but as a shock-absorber in view of the startling nature of the subject, the claim of C. Francis Jenkins, distinguished exponent of the inventive mind, is presented without further ado: "The broadcasting of motion pictures has been made possible by use of a prismatic ring, a new optical shape in glass, which has recently been brought to a rather high state of perfection. It has already been applied in extreme high-speed photography (1,600 pictures per second); continuous motion-picture projection machines; direct-reading ground-speed meters for airplanes; etc."

The transmission of photographs from one room to another, only a few steps intervening, at his laboratory, 1519 Connecticut Avenue, Washington, D. C., has been accomplished by use of these prismatic rings, which are protected by patents. The principle involved in the transmission of photographic objects through ether is that electromagnetic or wireless waves are susceptible to the impression of picture characteristics just as at present electrical waves may be translated into speech if voice characteristics are impressed thereon. Accepting the logic of this theory, the inventor claims that it is then only a matter of combining with these new ring prisms certain well-known elements in operative relation—elements to be found in any modern physics text-book.

A circular ring of glass, unpretentious in appearance, is the vital unit upon which the claim is based that photographs and motion pictures may be transmitted through space over short distances. The warped contour of this ring of transparent substances, when rotated across a beam of light, produces an effect on the latter comparable to that of a glass prism which changes the angle between its faces. Or, putting it differently, there is a constant change in its refracting angle.

The effect on a ray of light passing through this glass ring, having a fixed axis on one side of the latter, is to give to the ray of light on the other side of the glass prism an oscillation or hinged action in the plane of the diameter of the ring. Consequently, a ray of light passing thru this prism and spending its force on a picture surface at the top will travel across the picture surface to the bottom as the prismatic ring rotates. By the same token, the identical ray of light passing through a second prismatic ring, with its diameter set at right angles to the first, will embrace the picture surface from left to right. If then, reasons Mr. Jenkins, one of the prismatic rings is rotated one hundred times faster than the other, it will be seen that the picture surface would be covered, horizontally, in one hundred parallel stripes by the pointed beam of light.

Such is the behavior of these patented prismatic rings in conjunction with instruments now being developed in contemplation of a broadcasting service of motion pictures, not altogether dissimilar from the prevailing system of distributing vocal speech and music by means of the radio-telephone. The equipment for the transmission of pictures is composed of a pair of prismatic rings and a sensitive photo-electric cell

The outfit for the contemplated *reception* of motion pictures consists of another pair of these circular prismatic rings of glass and a light valve. The latter unit is a glass tube filled with carbon bisulphide solution, the tube being wound with wire somewhat similar to the winding formation of the tuning coil used in radio-telephony and telegraphy. Current given passage through the photo-electric cell of the transmitting apparatus fluctuates under the influence of variations in light values of different parts of the picture. This fluctuating current is impressed on electromagnetic waves, and is "picked up" by wireless receiving sets equipped with the prismatic rings. The current values, subsequently, are translated into picture values on the screen. The result is a duplicate of the scene broadcasted.

How do the amplified radio currents coming from the vacuum tube receiver influence the carbon bisulphide within the tube in such a manner as to act on the ray of light passing through it?

In answer to the above question Mr. Jenkins said:

"The construction of the light valve is based on phenomena described in most modern text-books on physics, that is, it is a well-known fact that polarized light passing through carbon bisulphide (a liquid) is rotated if this bisulphide lies in a magnetic field. Also, the polarized light is rotated proportional to the current strength creating the magnetic field.

"The construction of the cell is such that light from a fixed source, passing through a polarizer and then through a solenoid surrounding a tube of bisulphide of carbon impinges on an analyzer set crossed with respect to the polarizer. Such an arrangement will give total extinction of the light at the analyzer, if no current passes through the solenoid.

"However, when the current passes through the solenoid (creating a magnetic field within it), the plane of the polarized light will be rotated and will, therefore, pass out through the analyzer and on to the photographic plate. As the light is rotated in proportion to the current strength in the solenoid, the light intensity which reaches the photographic plate is also in proportion to the current strength. Therefore, the half tones of the picture sent from the broadcasting stations are reproduced as half tones at the receiving stations. That is, the reproduced picture at the receiving instrument is a faithful reproduction of the picture sent out from the broadcasting station in shadows, half tones, and high lights.

"Again, as this bisulphide cell acts as a weightless shutter, there is practically no limit to the speed with which it can respond to modulated current.

"The motion picture simply consists of a series of successive lantern slides thrown on the screen at a speed of sixteen a second, that is, at a speed which, by reason of persistence of vision deceives the eye into the belief that it is looking at a continuous picture on the screen. There is no difference between photographs, *i. e.*, 'stills,' and motion pictures, except in the speed."

Mr. C. F. Jenkins, Original Inventor of the Motion Picture Machine, is Here Shown at Work in His Laboratory, Together with the Apparatus Which Transmits Stationary or Moving Pictures via Radio or Wire, as Desired. The Underlying Principles Are Fully Explained in the Accompanying Text.

Movies of Prehistoric Animals

SUPERNATURAL in appearance perhaps, but uncanny, weird, grotesque, yet historically and anatomically accurate, are the motion pictures made by Major Herbert M. Dawley, in the wonderful photoplay, "Along the Moon Beam Trail." The story of the film is very interesting, but the most marvelous features presented are those in which animals, whose fossil remains and reproductions may be seen mounted at the American Museum of Natural History in New York City, actually seem to come to life and live in their original surroundings, battling with each other for the "survival of the fittest."

All the scenes reproduced are not only accurate as regards the structure of the animals themselves, but the trees and foliage have been reproduced by an authority at the aforementioned museum from actual fossil remains of plants known to have existed at the time when these animals roamed unchallenged over the plains of the otherwise uninhabited earth.

The photoplay story treats of two small boys who wander into the woods with their uncle. Here he relates the story of Queen Mab. Later, the same evening, the lads retire, and during the night they dream of the appearance of the queen. She grants them a wish and in an enchanted airplane they travel to the moon. Here they meet Mother Goose and the Man in the Moon and various other notables of nursery rhyme fame. Finally a pterodactyl, otherwise known as a blind lizard, one of the prehistoric monsters, chases them out of the sky. They land on another plane, which is the counterpart of the earth as it appeared over ten million years ago. Here they run about excitedly, finally locating in a cave, out of which they observe the surrounding country. Shortly thereafter they see a scaly monster approaching them, his head nearly scraping the ground; he is covered all over with scales and his hide seems practically impenetrable to ordinary bullets. Even if they had a gun the bullets would have no effect in stopping the progress of this slowly moving monster. He comes toward them scarcely moving his head and then, as he nears the mouth of the cave, he looks in and saunters away. During this period the closer views of the monster show in detail his horny and deeply seamed leathern coat.

A moment later another weird mammal approaches. This is the trachodon or duck-bill. He saunters toward the children in the cave and scrutinizes them closely. His tongue curls. From a distance the tyrannosaurus, or tyrant lizard, much smaller than the trachodon, is watching. He advances toward the duck-bill, intently observing every movement the latter may make. Duck-bill turns as though startled. He seems to scent the danger and turns to meet the challenge. The tyrant lizard and duck-bill interlock. Of course, the latter animal cannot successfully meet the onslaught of the smaller challenger, inasmuch as nature has not provided him with teeth or weapons. There is a terrific tussle, the children (as well as the audience) perceive every movement of the muscles of the contestants. Then the tyrant lizard fixes his sharp teeth in the neck of his adversary. The blood trickles down and the poor unfortunate duck-bill falls, another victim to Nature's inexorable law.

Some spectators would ordinarily think that somewhere, perhaps in Peru or Chile, some of these prehistoric animals had been discovered and actual photographs taken at the scene of action. Others might imagine that the photography is a result of psychical manifestations. Neither of the spectators would be correct in their thoughts. The truth of the matter is that these animals were actually built up after years of study upon scientifically accurate flexible metal skeletons. Their actions were reproduced after studying the peculiar bone formations of the animals at the museum aforementioned, paying particular attention to the attachment of the muscles and structure of the animals, as well as to their probable fighting possibilities. From encrusted remains, the texture of the skin was studied and reproduced. The animal skeleton was first covered over with a secret plastic molding compound, which possesses considerable elasticity and is the invention of Major Dawley. This was then covered over with an imitation hide, so that the quality of the coverings would correspond with those of the animals in real life. By means of stop-motion photography, in which the head, limbs or body of the animal were slightly moved from one position to another and photographs taken each time, the complete action was developed, the entire scenes were reconstructed. A scale was invented whereby the progression of the animal could at all times be anatomically checked up. Instead of the bones being moved by the muscular structure, movement of the bones by hand caused the muscles to stand out just as they would in life, due to pressure on one part of the elastic muscles causing a bulging of the free section.

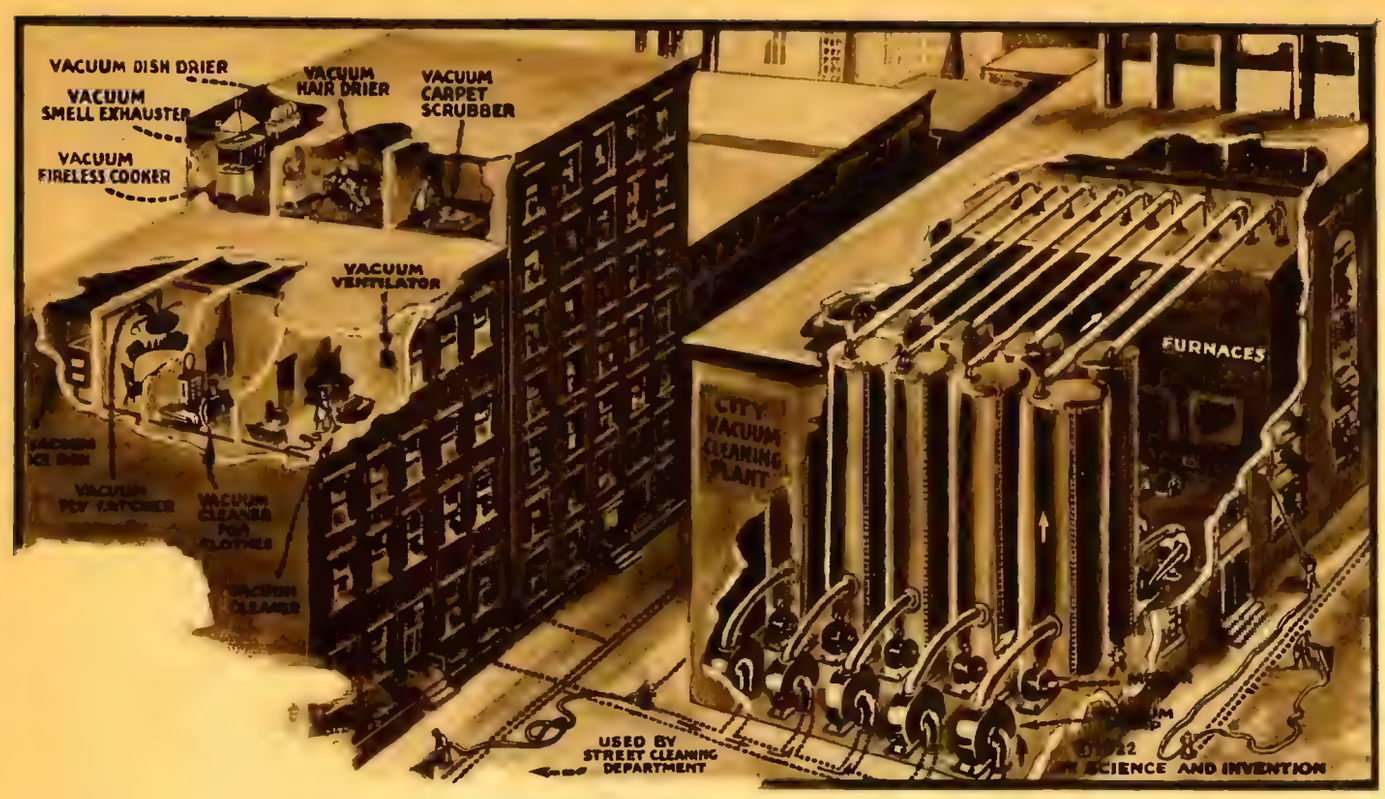
The animals are complete in every detail; the eyes stare and move, the tongue lashes from side to side and the tail coils and straightens itself again. During the battle even the labored breathing of the duck-bill is observed, as well as the death throes after this animal falls a victim. The skeleton itself is built up as nearly complete as possible with universal joints; the bones of the head, made to duplicate the real skeleton as far as necessary, are constructed of wood. The legs have wooden blocks mounted upon them over which the elastic molding compound is secured. Great care and exactitude was required in building up the scene itself and the "set" constructed after a study of fossil remains is naturally also correct.

Movies of Prehistoric Animals

Most Remarkable Are These Movie Photos of Prehistoric Animals. At the Top of This Page We See Two of These Monsters in Skeleton Form, Nearly Completed. As Shown in the Photograph, the Animals Are Built Up of a Skeleton With Universal Joints, With Ribs of Steel and Heads of Wood. Over These Skeletons the Muscles and Skin Are Laid. In the Center and Above This Caption is Major Herbert M. Dawley Working Upon a Model Skeleton of One of His Prehistoric Animals.

At. Fig. 1 the Tyrannosaurus and the Trachodon Meet in Deadly Battle. The Former of These Animals Is a Little Smaller, but Provided With Teeth; the Latter Is Toothless. Fig. 2 Is the Head of the Tyrannosaurus, While at 3 and 3 We See the Profile and Full Face View of the Trachodon. At Fig. 4 We Present a Semi-Final of the Battle, and at 9 the Tyrannosaurus Has Vanquished His Combatant. Figs. 5, 6 and 7 Are Respective Scenes of the Stegosaurus, Who Lumbers Into and Out of the Scene in the Motion Picture From Which These Scenes Were Taken.

This Motion Picture Film Created a Tremendous Furore When Sir Arthur Conan Doyle Exhibited a Very Similar One to the Magicians in New York. We Are Fortunate Indeed in Being Able to Place Before Our Readers These Photographs; the First Reproduced in Print. Every Action of the Animals Is True to Life. Thé Scenery Itself Was Built Up to Conform With Natural Fossil Formations, by an Expert at the American Museum of Natural History in New York City.



It Has Been Proposed by a New York City Genius That Either a Centralized Vacuum System for Cleaning the Streets be Tried, or Else Large Vacuum Cleaners Mounted on Motor Trucks for the Purpose. One of the Principal Reasons for Utilizing Vacuum Cleaning for Streets is, of Course, to Eliminate the Dust and Consequent Pollution of the Air With Myriads of Disease Germs for People to Inhale. With a Centralized Vacuum Cleaning Service, Such as That Proposed, Many Other Adaptations of Vacuum Systems for Housekeeping Suggest Themselves—Thus We May Have in the Near Future Vacuum Ice Boxes, Fireless Cookers, Insect Exterminators, Hair Driers, Ventilators to Take the Place of Fans, Dish Driers, Smell Exhausters, Et Cetera.

Vacuum Cleaned Cities of Tomorrow

NEW YORK CITY will save hundreds of thousands of dollars, cut the mortality rate by the elimination of disease-bearing dust and free 2,000 *whitewings* for subway construction and other needed work if it will sweep its streets with vacuum cleaners, says an appeal transmitted by the *Downtown League* to Street Commissioner Taylor recently.

Mr. W. A. Cochrane is father of the idea. He believes that a suitable motor-driven vacuum cleaner can be built at reasonable cost and that it can be operated economically. He says that the present system is as obsolete as the horse-car.

No doubt the cities of tomorrow will be cleaned by a piped vacuum system, the same as our homes are cleaned today, unless some better method is invented, of which we are not as yet aware.

Large central vacuum cleaning plants, operated by private concerns or preferably by the cities themselves, will be connected with pipes running through the streets the same as the present water, steam and gas pipes. The vacuum cleaner terminals along the street will resemble our present fire hydrants, and in one scheme it is suggested that street cleaners will draw the dirt and dust from the pavements and streets by means of long hoses, on the ends of which will be fitted suitable metal mouths, similar but larger than those now used in the home vacuum cleaner. A second scheme which has been suggested does away with all personnel, the suction action being automatic and continuous or semi-continuous.

In any event, the dust and rubbish sucked through the pipes to the central vacuum cleaning plant can be incinerated in suitable furnaces, or other uses made of it, which the engineer of tomorrow may provide for. Possibly this dust and rubbish can be suitably treated or manipulated so as to be compressed into briquettes for burning, constructing buildings, or some other application.

And when we have with us these large centralized vacuum stations, there are a number of other uses which will appeal to householders, several of which are illustrated in the accompanying picture. Houses will then be connected to the central vacuum system, and besides utilizing this great convenience for the purpose of cleaning the carpets in our apartment, we will no doubt have vacuum ice-boxes, vacuum fireless cookers, vacuum fly exterminators attached to chandeliers, etc., to draw all flies and other insects out of the air in the room, not to mention vacuum dish driers for the kitchen, vacuum hair driers for milady's boudoirs, smell exhausters to place over the kitchen ranges and air circulating registers, causing a draft or movement of the air in a room similar to that effected by the electric fan.

It is not any more difficult to pipe vacuum service than it is to pipe compressed air, and with the present highly efficient method of electric and acetylene welding of pipes it has become quite easy to make perfectly air-tight continuous conduits for long distances. We have mentioned here but a few of the many things that can be done when we buy vacuum service at so much per thousand cubic feet.

Coming once more to the cleaning of city streets by vacuum, which will mark a great step in advance indeed in this direction, we believe it will prove more economical, all things considered, to employ large portable vacuum cleaners, modeled somewhat like those we use in our homes, and propelled by gasoline engines, in other words, we could mount the large exhaust blowers, tanks, dust catchers, etc., on a motor truck chassis—at least this scheme would well merit its being tried out.

Aerial Battle Against Insects

Details of the first aerial battle in the war between insects and man were learned when J. S. Houser and C. R. Neillie, eyewitnesses, described a recent encounter between one airplane laden with poisonous dust and thousands of caterpillars firmly infecting the tops of a large grove of catalpa trees.

Casualties are estimated at 99 per cent. of the caterpillar enemy. The human forces suffered no harm whatever. The battle lasted only fifty-four seconds. In this time one airplane accurately dusted a six acre grove, containing 4,815 trees, 25 to 30 feet tall, whose leaves were being devoured by the caterpillars. The engagement took place at Troy, Ohio, and the campaign against the caterpillars was directed jointly by the U. S. Air Service, the Ohio Experiment Station and the Department of Forestry of Cleveland.

Airplanes have been used previously by the insect-fighters for scouting against the pink boll-weevil in Texas and forest insects in Canada and the United States, but this battle is believed to have opened a new era of offensive anti-insect warfare from the air.

Shipwreck in the Movies

ONE of the most exciting and thrilling American photo-plays features a shipwreck scene, which defies the best experts to detect how it was taken. In producing the shipwreck scene in question a considerable amount of mechanical ingenuity and scenic artists' skill were brought into play. As the accompanying illustration depicts, a faithful replica of a ferry-boat was built and mounted on a suitable cradle mechanism, so that it could be rolled back and forth in very realistic fashion. A goodly number of supers were rehearsed for the mob scene on deck, and while the boat is seen to be moving along with a slight roll and with suitable handling of the lights and background scenes to give the effect of a heavy fog, the bow of an ocean liner suddenly looms out of the murk and crashes into the boat, cutting through the deck and rail and causing the whole ship's structure to tremble, while the angry sea rolls in through the breech. The ferry-boat moves when suddenly bumped into by the ocean liner, as the cradle was suitably fitted with rollers for the purpose.

This is a very exciting scene when viewed from the movie audience chair; numbers of the passengers mounting the rail and jumping into the water, which was caused to assume an angry wave effect, thanks to large wave producing paddles operated by a motor at the side of the water tank.

The bow of the ocean liner was built with light steel plates with plenty of rivets to make it look massive, and this contraption was rigged up so that when released it slid down a slanting track with considerable velocity, small rollers being fitted under the dummy "liner."

The fog effect was cleverly worked out by suitable treatment of the background, and particularly in the handling of the electric light effects. The flood of water rushing over the deck, as the liner crashed into the ferry-boat, was created by playing two large fire-hose streams on a slanting board, secured to the rail and deck at one side of the vessel.

Of course, the moving picture cameras, several of which are always trained on such elaborate scenes as this, in the event that one of them may not take the scene just as desired, were focused so as not to show the hose nozzles or streams of water, but only the boiling effect where the water rolls over the deck. This scene appears in "The Sea Wolf" film play, taken from the book of that name, and those who have witnessed this particular scene will have slight chances of ever suspecting that it was or is not all that it purports to be.

Concrete Railway Cars

The principle of re-enforced conrete construction hitherto applied successfully to building lighters and even steamers is now being tested in Germany in the manufacture of freight cars with encouraging results. The first flat cars and gondola cars of fifteen tons capacity have undergone successful tests as to strength and stability, withstanding collisions when moving with a full load at twelve to fifteen miles an hour.

The chief advantage of the reenforced concrete cars in addition to their cheapness and ease of construction is their resistance to weak acids in such freights as coal, slack, etc., which attack and quickly eat away the metal parts in iron and steel cars. Cars of fifteen and twenty tons capacity are somewhat heavier than steel cars of the same size, but this difference disappears in forty-ton cars, with which the German state railroads, following the trend of the times, plan to reequip their lines.

One of the Great American Photoplays Required a Scene Where an Ocean Liner Crashes into a Ferryboat. A Great Deal of Ingenuity and Clever Lighting, as Well as Art Effects, Were Evolved in Staging This Realistic Crash for the Motion Picture Camera. The Prow of the Ocean Liner Was Placed at the Upper End of a Track, and at the Psychological Moment the Director Yelled the Order Through His Megaphone to "Let Go"—and Down the Greased Tracks Slid the Dummy Prow of the Steamship. The Effect of Inrushing Water Was Created by Playing Two Fire Hose Streams Against a Board Placed at an Angle, as Shown.

Unlimited Destruction

By ERNEST K. CHAPIN

PRESIDENT SEABURY leaned back in his chair and frowned as he pushed a pile of papers that lay on his desk before him. "'There is something rotten in the state of Denmark,'" he quoted under his breath, "but I'm afraid rottenness is not confined exclusively to that state. The whole world fairly reeks with it, and unless something can be done to prevent trouble we are in for a dose of it that will put civilization on the rocks." His soliloquy was interrupted by the hurried entrance of the Hon. James Bushworth, his secretary of state.

"Any news?" he asked as Bushworth entered.

"Alas, yes," he groaned in reply. "The Palmola islanders have revolted, seized the Japanese garrison, tortured and murdered the handful of soldiers within it, and put themselves in complete possession of their native isles. Unquestionably Japan is furious and will take vigorous steps to avenge the atrocities perpetrated upon her soldiery and to recover her possessions."

"Beyond a shadow of a doubt," agreed the president gravely, "and in the meantime what is the rest of the world going to do about it? One powerful group of nations have contested Japan's right to these islands, while an equally powerful group have not only recognized her claim but have promised support if it is needed. Practically every nation on earth has some vital interest affected by this controversy, already one of long standing, and now that the unfortunate islanders have taken matters into their own hands the chance of amicable settlement seems indeed remote. If it were not for the strategic importance of these islands, their value as a naval base and their vast mineral wealth, the matter might successfully be arbitrated, but considering the problem in the light of present world conditions it is obviously impossible to do all that. With the ten-year naval holiday at an end, with commercial rivalry at its height, with all corners of the earth closed to colonization, with race hatred, fear and jealousy more intense than ever before and with the wounds of the last great war unhealed, to say nothing of the fresh wrongs daily committed, Bushworth, it would seem that the world is again on the brink of a great war. And just as the murder of a single man in 1914 set the nations at each other's throats, so now in 1934 I believe this miserable skirmish in the Palmolas will set them off once more."

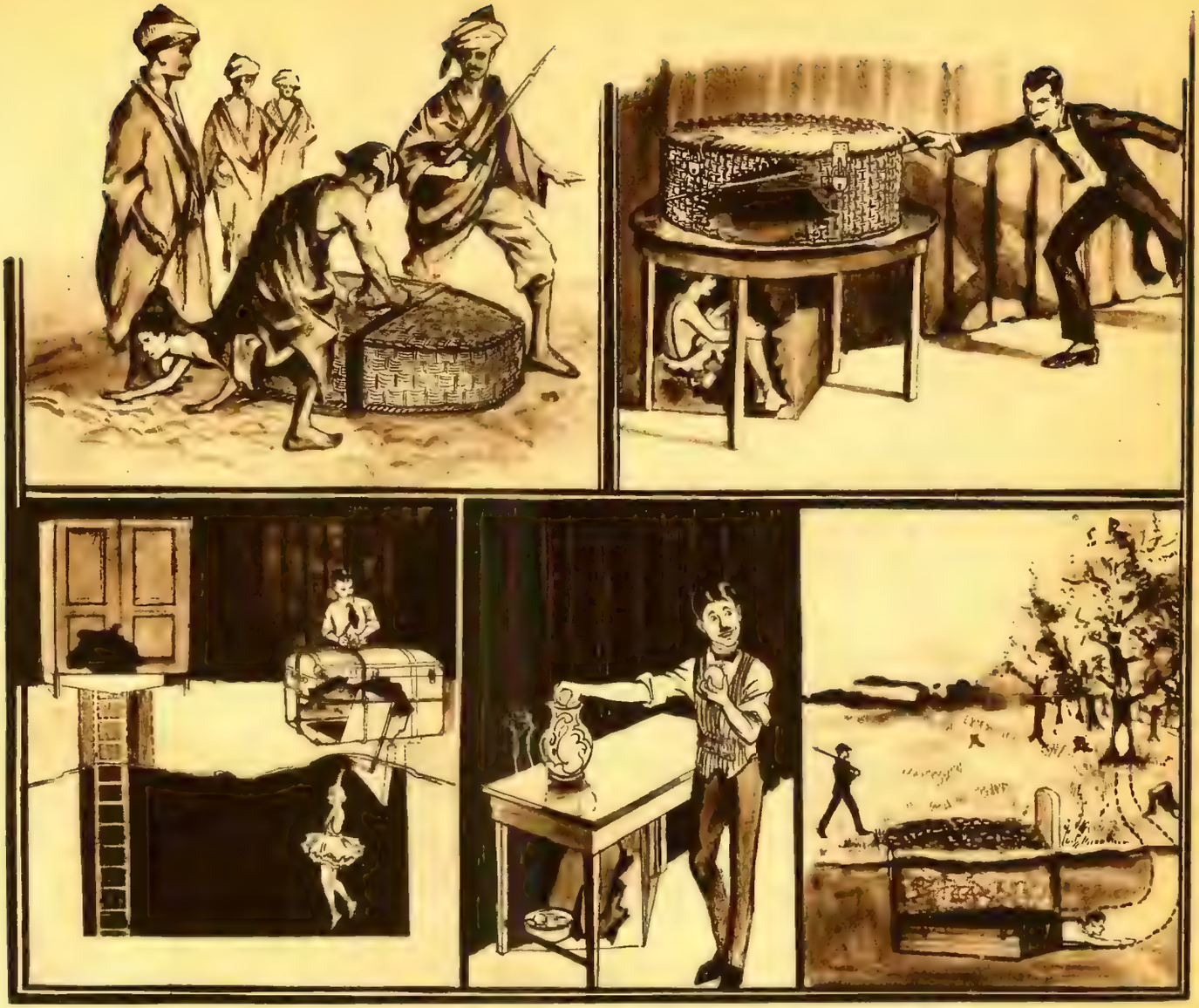
"And what a war it will be," exclaimed Bushworth. "A fight to a finish—with machinery a thousand times more destructive, with gas a hundred times more deadly than any that has been used before, and with all the forces of nature invoked to hasten the destruction of man, Mr. President, another war will mean the end of modern civilization. No nation can drag its people through such a war and survive. The forces of reaction and Bolshevism, already a menace in all parts of the world, will sweep away modern forms of government and plunge the earth into the same state of chaos that Russia now finds herself."

"We must waste no time in words," returned the president. "The bubble of danger, that has been expanding for some time, has at last burst and we must act quickly if we are to avert or postpone the calamity." And so saying the president and his secretary laid aside every other task and bent their energies to the one of preventing a world war.

By the end of the day the president had communicated with every nation of consequence and had done everything possible to delay, if not prevent, the disaster which seemed inevitable. At last, wearied by his exertions, he dismissed his stenographer and rang for his private secretary. "Digby,"

(*Continued on page* 382)

"From the Solitary Glass Eye a Blue-Green Pencil of Light Shot Forth, Quivered for an Instant on the Surface of the Boulder, and as Quickly Disappeared. Almost Instantly from the Rock Flashed Skyward a Blinding Light Accompanied by a Report Louder by Far Than Any Explosion. The Crew, at First Stunned by the Shock, Were the Next Moment Deluged by a Hugh Wave That Completely Swept Over the Vessel, Washing Many of the Men Into the Sea. . . ."



All Travelers Who Have Visited the Orient Have Seen the Famous Basket Trick, In Which a Hindoo Boy is Placed in a Basket and a Sword Plunged into it Repeatedly. On Opening the Basket, the Boy is Found Alive, or Perhaps Has Disappeared to Come Running into the Scene from a Distance of a Hundred Feet or More. He Escaped Through a Slit in the Basket Under the Robes of the Magician and His Assistants (Upper Left). The Upper Right Hand Diagram Shows the Way a Similar Trick is Performed on the Stage. Two Mirrors Conceal the Victim from View. These Mirrors are Attached to the Rear Table Legs and Slant Forwardly, Joining at the Center. The Lower Diagrams Illustrate: To the Extreme Left—Person Escaping from a Trunk and Later Found in a Cabinet, the Cabinet Itself Being Mounted on Legs. In the Center Illustration is the Orange Trick: The Assistant in Back of a Mirrored Table Conceals the Orange in a Black Gloved Hand Blending with the Draperies. At the Extreme Right, the Trick Performed by Fakirs, Known as "Buried Alive." The Tunnel Communicates with a Hollow Tree from Which the Fakir Escapes.

Mystic Feats of Hindoo Fakirs

By LEON GREBSNAL

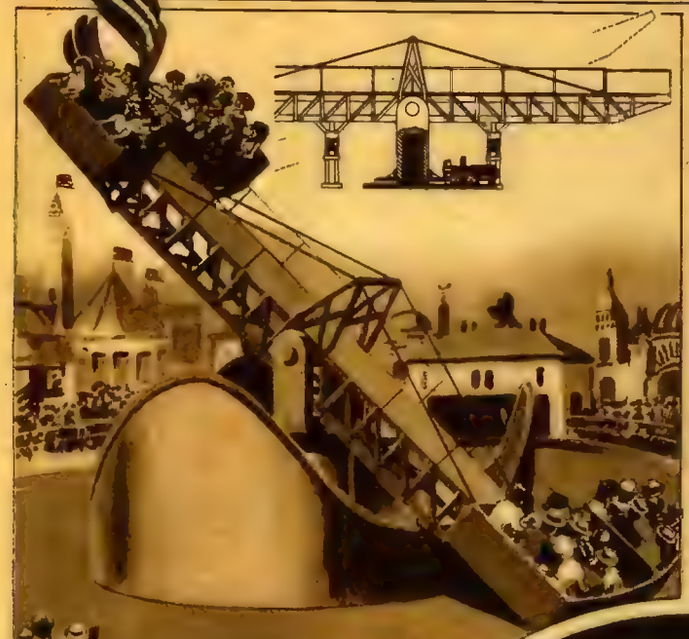
SIR ARTHUR CONAN DOYLE in his self-appointed mission to this country has rearoused widespread and intense interest in all phases of occultism, including ghosts, fairies, departed spirits, and even the long-familiar performances of Hindoos, who make a pretense of being Yogis, but who are mere fakirs; with which last-named some skeptical people are inclined to identify the extraordinary spiritualistic manifestations reported by the eminent British lecturer, author and scientist. Such identification would be, however, equivalent to utter condemnation of all the phenomena related and described by Sir Arthur, for there can be no question that the performances of Hindoo fakirs are nothing in the world but clever trickery, such as is practised by every sleight-of-hand entertainer since the days of the famous Signor Blitz. It is true that the exaggerated accounts given by many travelers are calculated to produce the belief that innumerable vagabonds and mendicants in India are endowed with supernatural powers and are able to perform feats inexplicable by any known law of nature. But the fact is that the so-called Indian fakir is indeed a faker in our common opprobrious sense of the word. He is a juggler, a trickster, and his apparently magical performances are sheer deception. True Yogis do appear to possess powers transcending ordinary conceptions of nature, but they never make public exploitation of them.

One of the best known of the performances of Hindoo fakirs is what is known as the Basket Trick. A small boy is placed within a large oblong basket, the lid of which is strongly tied down. The fakir then thrusts a sharp sword into the basket; a scream of mortal agony is heard; and the sword is withdrawn dripping with blood. The basket is then opened and, to the relief of the horror-stricken observers, is found to be empty, while the child, safe and sound, appears at a distance among the bystanders. In some cases the child is found in the basket, but quite unharmed.

The explanation of this is quite simple. The fakir has a number of assistants around him, all dressed and looking alike. In one side of the basket there is a slit, imperceptible when it is closed, but which can easily be opened by springing the osiers apart. When the fakir leans over the basket and places his knee upon it, to draw as tight as possible the straps which secure the lid, the child crawls out through the slit underneath the fakir's ample flowing robes, and thence under the robes of his assistants who stand close by, and so makes his way unperceived to the outskirts of the crowd, whence he returns after the basket has been opened. The screams apparently uttered by the child within the basket are the result of ventriloquism, and the blood on the sword is the blood of a bullock or some other red fluid, contained

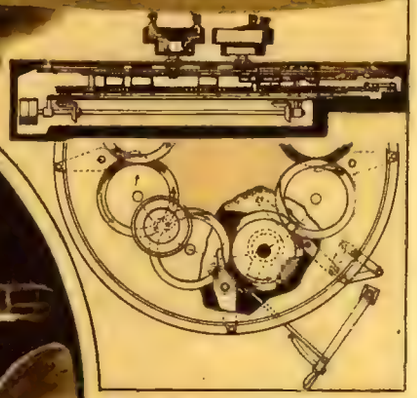
(*Continued on page 372*)

Scientific Fun

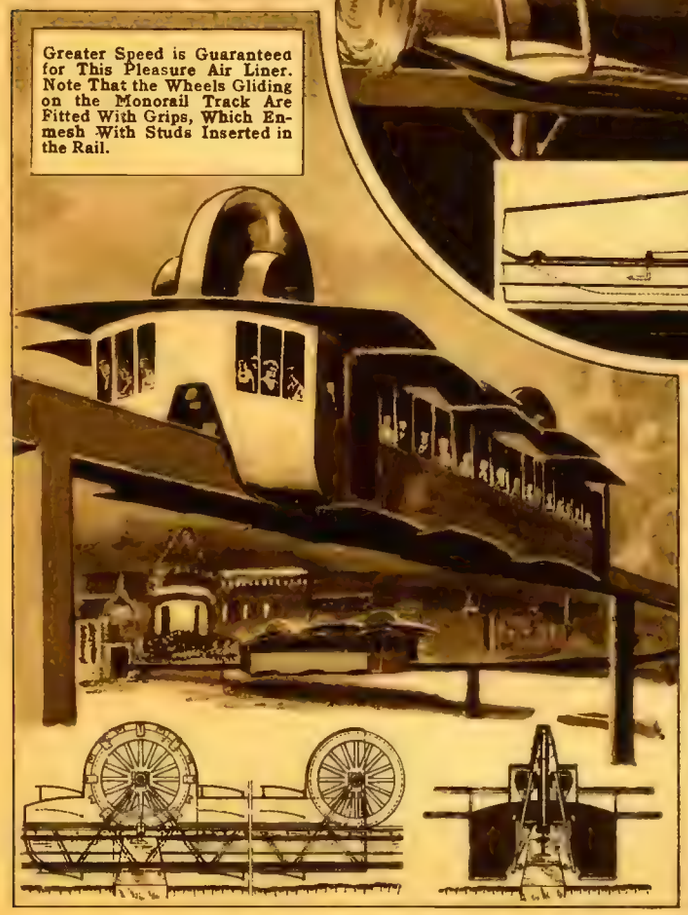


The Amusement Apparatus Illustrated on This Page Were Recently Patented. Above We See a Walking Beam Mounted on Rollers Which Travel Over an Undulating Track. The Entire Device Rotates About the Center. Not Only do the Passengers Experience a Rapid Rotary Movement, But Also a Marked Swinging Sensation, as the Device is in Operation.

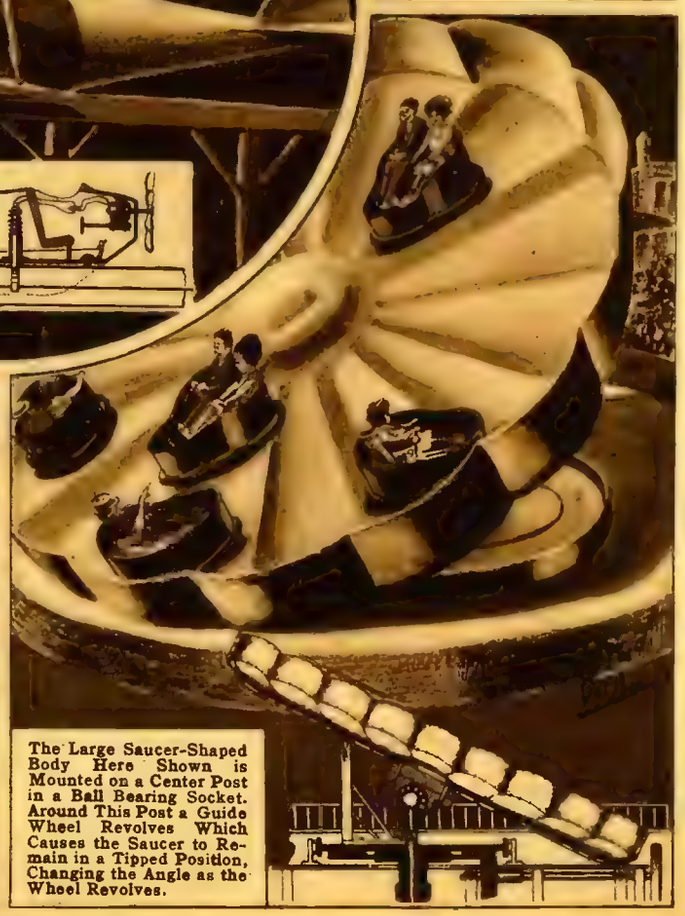
Cars Moving on a Rigid Platform Actuated by Wheels Revolving Under That Platform Provide Exhilarating Sport. So Cleverly is the Device Made that Accidents Are Not Likely to Occur.



Sixty Miles an Hour, in a Safety Plane. The Electric Motor May be Inclined, Changing the Position of the Propeller, and Raising the Plane from the Rail.



Greater Speed is Guaranteed for This Pleasure Air Liner. Note That the Wheels Gliding on the Monorail Track Are Fitted With Grips, Which Enmesh With Studs Inserted in the Rail.



The Large Saucer-Shaped Body Here Shown is Mounted on a Center Post in a Ball Bearing Socket. Around This Post a Guide Wheel Revolves Which Causes the Saucer to Remain in a Tipped Position, Changing the Angle as the Wheel Revolves.

Fish That Walk

By DR. ERNEST BADE

Among the Greatest Freaks in Nature Perhaps Are Fish That Walk. This Fish (Anabas Scandens) Employs Its Fins for That Purpose.

TWO Arabic travelers of the ninth century reported the existence of an Indian fresh water fish which was able to walk about the land. The same fish was later described by the scientist Daldorf, who saw this finny creature in a fissure in a palm tree not far from a pond. As it climbed it pressed its pointed and extended gill covers against the sides of the crack, threw its tail back and forth, pressed the thorn of its anal fin against the support, and closed its gill covers with a jerk. In this way it advanced a step.

Today this fish is known as the climbing perch, *Anabas scandens*, but modern travelers have nothing to say about such lofty excursions, and one must come to the conclusion that the tree-climbing proclivities of this fish existed only in the imagination. The Indian name of this fish, "Undi-colli," "Paunieri," "Nozagri," et cetera, does not change the fact, although such names are equivalent to tree climber. It is true that the climbing perch can move about the land for a considerable period.

This Fish (Periophthalmus Koelreuteri) Exerts a Powerful Walking Action With Its Front Fins.

As the waters inhabited by these fish dry up, the existing puddles become overstocked, and as the water gradually disappears, the fish leave their old home to seek other waters. They depart by hundreds, traveling over the land, scattering in all directions. Then the gill covers are fully extended and the pectoral fins spread out. The former are bent outward like a joint, the pointed end seeking a firm hold, by a twisting and turning movement of the body, especially of its posterior part, the creature is jerked forward. Then the thorn of the gill covers again seeks a firm hold. In this way the climbing perch is able to move quite rapidly over the ground and covers considerable distance.

If the fish do not find water during their travels, or if they find other practically dry ponds, they will dig themselves into the mud and one can find them here at a depth of one and a half feet. The upper layer of mud has caked and is so brittle that it powders at the touch. The fish generally lie in a moist layer of soil, but this can even dry up without injuring the life of the creature. When the ponds are again filled with water after the first rains, the climbing perch works its way out of the mud and lives in the water as usual.

Some catfish inhabiting inland waters also travel to other ponds when the waters in which they live dry out. The most important of these is the armored catfish, *Doras Hancockii*. Such a walk may last an entire night, for the animal can live many hours out of its natural element, even though the burning rays of the sun shine down upon it. Under such conditions the catfish presses its gill cover tightly over the comparatively small gill openings. Movement along the soil is accomplished by its long and strong pectoral fin-thorns and by the elastic and swaying caudal fin. In this way the fish is capable of moving as fast as a slow walking man.

The mud-skipper, sometimes known as the walking or jumping fish (*Periophthalmus Koelreuteri*), has earned the complete character of a *land fish*. It is an inhabitant of the coastal regions of the Indian and the western Pacific oceans, as well as of the western coast of Africa. It lives an amphibious life, and, at the time of the ebb it gambols about the mud flats of the mangroves hunting insects. This life in the air is made possible by the structure of its gills, whose openings are exceedingly narrow, and this feature prevents the rapid evaporation of the water held in the cavity of the gills. The ventral fins are situated far to the front and are grown together. They act on the principle of the suction disk. The pectoral fins have developed strong muscles and are used by these creatures like legs. It is even possible for the fish to lift itself with their aid. Then it raises the front part of its body and lets its large protruding eyes, which are at the top of the head and can be extended or withdrawn, observe all its surroundings. The eyes are movable to a high degree, and are also provided with lids.

The movements on the mud are somewhat like those of an awkward jumping frog. If danger threatens these creatures are able to flee with the speed of lizards. They hurry towards the water or dig themselves rapidly into the mud. To catch or stalk them is difficult as they are exceedingly watchful and very shy. When the fish consider themselves safe they skip about by slightly bending and stretching their body, supporting themselves on their pectoral and caudal fins, leaving a characteristic trail.

When stalking its prey, the walking fish behaves just like a cat. It slowly approaches the insect, step by step. Suddenly it hurls itself through the air, and its prey disappears in its wide mouth.

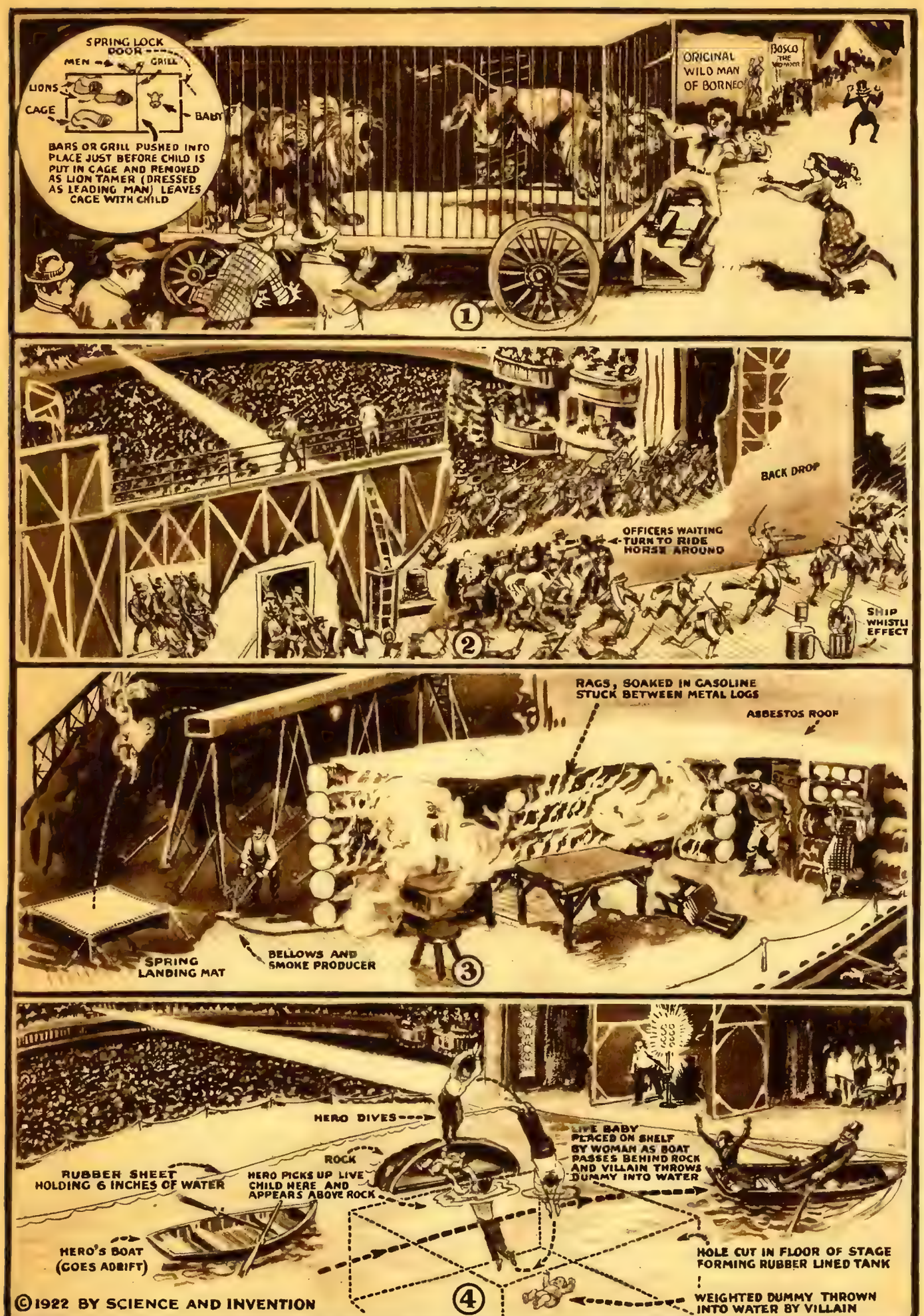
The "Ceratodus Forsteri" Poses in This Fashion Frequently on Its Leg-Like Fins.

The animal even climbs upon the stilt-like roots of the mangroves. They hold themselves firmly to the roots with their fins, meanwhile shoving themselves upward with their tail. The same fish always congregate in small schools and the peculiar thing is that only equal sized individuals are seen together. Sometimes they rest quietly upon the sand; at others they chase each other about in an abandon of play.

The pectoral fins of the gurnards (*Triglidae*) are peculiarly formed. According to the species two or three of the rays are free and these somewhat resemble fingers. In action they can be likened to legs or feet, as they enable these creatures to literally walk on the bottom of the ocean. Then the animal slightly lifts the hind part of the body, carefully feels its way forward and, with an al-

(*Continued on page* 395)

The Fourth Specimen of Walking Fish (the Trigula) Has Peculiar Appendages Rather Well Suited for Maintaining Its Equilibrium.


SPRING LOCK DOOR
MEN
GRILL
LIONS
CAGE
BABY
BARS OR GRILL PUSHED INTO PLACE JUST BEFORE CHILD IS PUT IN CAGE AND REMOVED AS LION TAMER (DRESSED AS LEADING MAN) LEAVES CAGE WITH CHILD
ORIGINAL WILD MAN OF BORNEO
BOSCO THE WOMAN
1
BACK DROP
OFFICERS WAITING TURN TO RIDE HORSE AROUND
SHIP WHISTLE EFFECT
2
RAGS, SOAKED IN GASOLINE STUCK BETWEEN METAL LOGS
ASBESTOS ROOF
SPRING LANDING MAT
BELLOWS AND SMOKE PRODUCER
3
HERO DIVES
LIVE BABY PLACED ON SHELF BY WOMAN AS BOAT PASSES BEHIND ROCK AND VILLAIN THROWS DUMMY INTO WATER
ROCK
RUBBER SHEET HOLDING 6 INCHES OF WATER
HERO PICKS UP LIVE CHILD HERE AND APPEARS ABOVE ROCK
HERO'S BOAT (GOES ADRIFT)
HOLE CUT IN FLOOR OF STAGE FORMING RUBBER LINED TANK
©1922 BY SCIENCE AND INVENTION
4
WEIGHTED DUMMY THROWN INTO WATER BY VILLAIN

Four Spectacular Stage Scenes Are Here Illustrated and Described by One Who Helped to Put the Scenes on. The First Scene Shows How Child Was Rescued from Lions' Den; Second Scene Shows How a Few Soldiers Marching Around and Around Gives the Audience the Effect of an "Army" Embarking; the Third Scene is That of a Burning Log Cabin Used in One Melodrama, While the Fourth is from a Melodrama in Which the Hero Saves the Child from a Watery Grave.

Spectacular Stage Tricks

By H. WINFIELD SECOR

THE accompanying illustrations show four spectacular stage scenes from shows which have enthralled audiences throughout the land. All of these theatrical productions, with the exception of one, produced the scenes in the course of repertoire work, and it must be said to the credit of those who conceived and engineered these interesting, not to say thrilling, stage settings of a few years ago that they seem to have been the "Last of the Mohicans," as it were, for the writer has certainly seen nothing like these productions of late years. True, New Yorkers were treated to a royal spectacular drama in "In the Night Watch" last season, but there seems to be a dearth among present-day stage plays of sufficiently well-worked-out scenes in the average class of dramas and melodramas.

RESCUING A BABY FROM A LION'S DEN

Referring to the accompanying illustration, let us glance at the top scene, showing the lion's cage, used with tremendous effect in a thrilling melodrama of a decade ago—the same company may still be touring the states for all I know—but, if so, I have heard or seen nothing of it. In producing this scene in one of the acts of the melodrama—the writer having been present on the stage at the time—a strong iron-barred cage was taken along with the company to house three lions, one of them being nearly blind, as I recollect. The essence of this scene culminated at the point where the villain threw a baby into the lions' cage. The audience gasped with horror, some of the women nearly faiting no doubt, but the child could not be harmed had they but known that several stage attachés were stationed back of the tent canvas, just behind the lions' cage, to push a barred gate in place the instant the child was placed therein by the villain. This scene was enacted in a semi-dim light and the bars sliding in place could not be seen by those in the audience, especially as the cage was placed well back on the stage. The action in this particular part of the scene took place very fast, which helped matters a great deal, of course. The woman whose child the villain had thrown into the cage shrieked and wrung her hands; the hero (the lion tamer dressed and made up to exactly resemble the leading man) comes on the scene a few minutes after the child is placed within the cage and dashes into the lions' den. He clutches the child from the floor, turns about, and in a moment is out of the cage, the door automatically swinging shut and locking with a snap lock. The iron bars separating the lions from the end of the cage where the child was, were removed just as the hero (lion tamer) made for the door. It sometimes happened that he did not get out of the door before a lion pounced against him; he showed us some scars on his back where one of the lions had clawed him badly, when the door refused to open quick enough, and the lions had to be fought off by stage attachés armed with iron spike poles. We used to tease the lions just before the show, and they were always kept a little hungry, by regulating their diet, so that they would not be too lazy to put up a good roaring battle when this scene took place.

To those in the audience the scene presented one of the most thrilling rescues ever attempted on the stage, and it was without a doubt fraught with considerable danger, as can be seen from the foregoing. About the funniest incidents connected with one of these lion shows happened when a healthy young lion about the size of a full-grown St. Bernard dog walked out of his cage through an open door one morning, sauntered out through the stage door and up the main street. If you ever saw people scamper to get into stores and other places of retreat they certainly did then. The lion had had his breakfast of fifteen pounds of raw beef and felt in a docile mood, however. His tamer, as soon as he was apprised of the fact, dashed up the street and soon came back with Mr. Lion, who acted as gentle as a kitten.

HOW ARMIES ARE EVOLVED ON THE STAGE

Another show which possessed many novel points of interest, both from the viewpoint of the audience and also of those privileged to stand back-stage, was called "Across the Pacific." No doubt many of us remember that thrilling melodrama in which we were treated to the inspiring sight of hundreds of Uncle Sam's soldiers marching aboard a transport bound for the Philippines. The way this scene was handled, at least in some cities, was as follows: A few squads of soldiers from the local National Guard unit were hired for the occasion, as they possessed the necessary military training for the marching maneuvers, and they also brought their own guns in most cases.

At first a number of the soldiers are seen lolling about the dock, while the leading characters of the play carry out their dialogue. Finally the audience is stirred to a high pitch when the bugle sounds and the soldiers start to fall in line and march toward the transport. The effect of hundreds of men marching aboard is obtained practically in all such shows as this in the manner depicted in the accompanying illustration. The boys in khaki march through the door in the side of the ship and then run like mad across the stage and reform in lines at the opposite side, ready to march across the stage again. Needless to say, this action can be kept up as long as the director of the show deems it desirable.

In one show featuring a marching soldier scene, such as this, a horse was used for one of the officers to ride, and he frequently reappeared in the long column of marching men. When it came to the door of the fort in the scene I now have in mind the officer astride him dismounted quickly and another officer mounted him and scampered across the stage, ready to appear at the other side. The artist who drew the accompanying picture took part in this particular show, featuring the officer and his horse, and no doubt a great many of the audience snickered when they heard the clattering hoofs of the quadruped as he was hustled across the stage, so that the captain could appear at the head of his company.

The transport in the scene previously referred to finally steamed away from the wharf by the simple expedient of being pushed out of the scene by stage hands behind the boat, this part of the setting being mounted on wheels for the purpose. Some soldiers appeared on the deck of the ship; from the back of the stage they could be seen standing on an improvised platform in the manner here illustrated, this platform being attached to the ship, so as to move with it.

In some of these soldier shows a brass band helped to enliven the occasion and put plenty of pep into it. The "Across the Pacific" show boasted a real machine gun, which was used in one of the Philippine warfare scenes, where a block-house was defended by American soldiers. The firing on this occasion was so intense that it caused some of the plaster on the ceiling of the theatre where the writer happened to be to fall, a piece of this plaster just missing a bald man's head at one of the performances.

The hero of this play saved the day, when the machine gun jammed and all the soldiers were dead or dying about him, by firing 100 revolvers, one after the other, with lightning rapidity. I have seen lots of jobs I would not care to have, in my travels here and there, but one of the meanest jobs I think was that of the company's armorer, who had to clean and oil these one hundred odd revolvers every morning, in preparation for the next matinee and evening performances.

In closing it should be mentioned that some of these traveling shows of the old 10-, 20- and 30-cent melodrama class could boast of very artistic and beautiful scenes, well worked out with electric lighting effects and other devices. The steam whistle effect used, for instance, as the transport departed in the scene just described, was produced by a large air whistle blown by compressed air, supplied from an air tank and pump.

Speaking of war-time settings as produced on the stage, there was one show which widely advertised the fact that they had a 12-inch gun scene and that the gun exploded while being fired. This sounded pretty strong, but the writer well remembers this play and the effect was certainly very well produced. A large cannon made of wood and cut into sections or segments was

(*Continued on page* 398)

September Feature Articles

Motion Pictures in Natural Colors.

The End of the World—How Soon? By Ivan L. Smith.

How Microscopic Study of Bullets Solves Crimes. A French Contribution to the Science of Criminology.

Why a Smooth Golf Ball Won't Fly Straight. By P. A. Vaile.

A Substitute for Wood. By Persis Bingham.

What the Human Body is Made Of.

Animal Monsters in Miniature. By Dr. Ernest Bade.

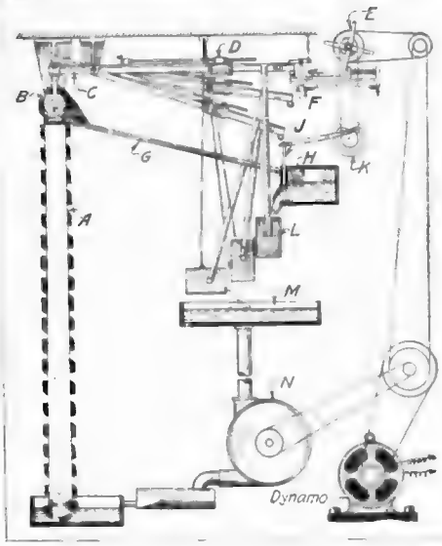
Dr. Hackensaw's Secrets—The Secret of Electrical Transmission. By Clement Fezandié.

Radio Concerts from a Lamp Socket—How to Do It. By A. P. Peck.

Usual Big Radio Section with Data on How To Build Sets and Improve Them, Including Popular Monthly Article by Armstrong Perry.

Magic With a Conical Mirror—the Funniest Pictures You Ever Saw. Freak of Optics. By Juan Camps Campins.

The Latest Ideas in "Silhouette" and "Talking" Movies.



At Left: Fig. 1—Read the Description of This Machine and Then Send in Your Explanation of the Reasons It Will Not Produce Power or Even Move. This Machine is an Inventor's Attempt to Produce Perpetual Motion. The Buckets Shown at "A" Are Moved Upward by Levers "C" Operating Through Crank-Shaft "B."

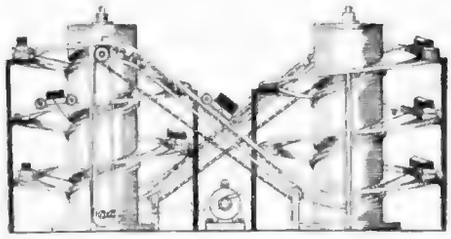


Fig. 3—This Endless Track is Another Inventor's Dream to Secure Something for Nothing. The Four or Five Cars Coursing Downward on the Long Spiral Track Theoretically Raise the Car on the Short Incline! The "Excess Power" is Used to Drive an Electric Generator and Light Lamps, etc.!!!

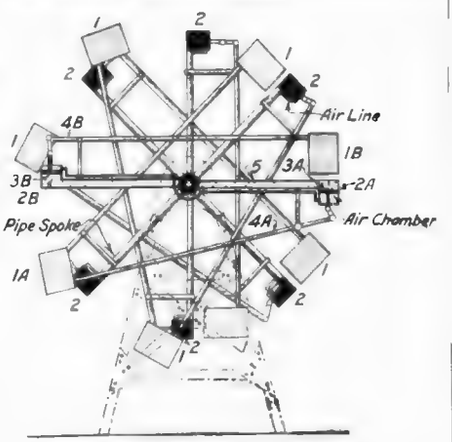


Fig. 2—The Machine Shown on Our Cover is Illustrated in Detail Above. This Device Will Not Work, But Why Not? You are to Tell Us the Reason. The Explanation of the Diagram is Given in the Text.

The Truth About Perpetual Motion

By JOSEPH H. KRAUS

PERHAPS more minds have worked upon *Perpetual Motion* and more money has been spent by inventors and financiers in trying to attain it than on many other researches of practical merit. Before discussing the various ideas on the subject of perpetual motion, let us first determine just what the words imply. There are two meanings implied in the term perpetual motion. The literary meaning, which refers to *unceasing motion*, such as we see in the movements of all heavenly bodies, the tides, waves in the ocean, etc.; and the conventional meaning which is used throughout in this article, namely, *self-motive power*. Everyone knows that in raising a weight, power is used. That same weight if it descends will generate power. The inventors of perpetual motion devices therefore reason that a machine could be built which would generate sufficient power to raise the weight; then again use that self-same power to deliver energy, sufficient at least to raise the weight once more. No outside source of power, other than the force of gravity, is permissibly employed in these mechanisms, unless, of course, the energy developed by the machine will generate sufficient power to again drive it, regardless of whether that power be electrical, explosive, or what not

The fallacy of many of the machines here described can be pointed out, ignoring completely the friction on the bearings or moving parts. The first perpetual motion device is the one submitted to us by Mr. José Martinez. (See Fig. 1.)

The First Prize Problem

In this device four chains of buckets are found, all operated on the same crank shaft. The operation of the device is supposed to be as follows: The endless chain of buckets A, being filled with water on the ascending side, are exactly counterbalanced on their crank shaft B by the adjustable sliding weights D, acting through the levers C, on this crank shaft. Cam K is now permitted to turn, which allows water from the reserve tank H to flow out into buckets L. When one of these buckets is filled, cam K, still revolving, closes the valve J and draws the trigger F forward by the action of the sprockets on the trigger release E. This means that the crank shaft, which was formerly exactly counterbalanced to such a degree that even an ounce of additional weight would cause it to revolve by causing the lever to become unbalanced, is now permitted to move, due to the added weight on one side of it. When the bucket descends to its lowest point, it tips over, the water, pouring into the trough M and descending through the pipe 150 feet long, produces sufficient water head or pressure to turn the water turbine. This turbine in turn not only drives the trigger release E and the cam K, but also delivers *excess power*, according to the inventor.

$150.00 in Prizes

THE three perpetual motion systems illustrated in Figs. 1, 2 and 3, each carry with them a prize of $50.00 in gold for the best explanation of why they will not work. In other words, for the best explanation of why Fig. 1 will not perform or operate as described in the accompanying article, a prize of $50.00 will be awarded. For the best reason why a machine made as shown in Fig. 2 will not operate, a prize of $50.00 will be awarded. For the best explanation of why Fig. 3 will not operate, a prize of $50.00 will also be awarded. The total in prizes for this contest, which closes September 15th, 1922, is $150.00. No letters will be accepted for the contest post-marked later than midnight September 15th. In the event of a tie by two or more contestants sending in equally worthy explanations, an identical prize will be awarded to each. The opinion of the judges is final. Contestants may enter as many explanations as they desire, which should omit the consideration of energy and frictional reasons. Consider for the sake of the arguments, friction as nil. Manuscripts must not be over 500 words long for each explanation, and a contestant may compete for any or all of the prizes.

The explanation as to why this clear conception will not work is left to the reader. It should be simple and the factor of friction is to be ignored. It may be mentioned that the relation of the weight to the power arm in the levers is changeable, and two buckets on each chain full of water turn over the top of the crank shaft B for one complete revolution of the crank shaft.

For the best explanation of why Fig. 1 will not work, a prize of $50.00 will be paid.

Second Prize Problem—Machine Shown on Our Cover

Fig. 2 is the machine shown on the cover of this magazine, and illustrated again herewith: 1 are weights; 2 are cylinders in which pistons, 3, operate, through levers, 4. It will be seen from the diagram that in the position of the machine as shown the piston 3A in cylinder 2A is being forced upward by weight 1A, acting through lever 4A, compressing the mercury in these pistons and forcing it through the tube 5 to cylinder 2B. The piston 3B is being lifted upwardly, forming a partial vacuum on that side of the machine, caused by weight 1B descending and acting upon the piston 3B through levers 4B. This action, according to the inventors, Messrs. Larson and Ross, is to continue indefinitely. Why will this machine not work? We offer $50.00 for the best explanation of its failure to operate.

Third Prize Problem—Machine "Actually Patented"

On April 20, 1920, Mr. Wenzel Zeman of Schenectady, N. Y., actually secured a patent on a power transmission apparatus, which seemed very, very much like *perpetual motion*. We communicated with Mr. Zeman, and were informed that his system was indeed "the only perpetual motion device worthy of consideration." In the patent, the number of which is 1,337,873, mention of a motor is made in the specifications, although in none of the four patent claims is such use of the motor claimed. This mention, according to the attorneys, must be inserted; otherwise the patent would be purely a perpetual motion system, and inasmuch as the U. S. Patent Office will not accept patents on perpetual motion schemes, unless a working model is submitted, it is quite necessary to enter driving means for the device. According to Mr. Zeman, however, the power transmission apparatus *is* perpetual motion. He has not been able, so far, to produce a model that works, and never will be able to do so.

The device is supposed to operate as follows: A long spiral descending track is arranged about two vertical columns; these columns are rotatable. It is evident that the descending spirals are much longer than the ascending inclined tracks. A link chain assists the cars upwardly along the inclined slope to the top of the spiral, where the car is released. Here it meshes with the revolving upright drum, turning it around. According to the inventor, there will be five or more cars constantly descending, while one ascends. Consequently, the drums as they revolve will lift the weight of the car, which ascends easily, because the combined weight of the five cars moving on the downward course on the spiral is greater than the weight of one car. This action is to take place indefinitely, and power removed from the driving wheel. (See Fig. 3.) The third prize of $50.00 will be paid for the best explanation of the fallacy of this scheme.

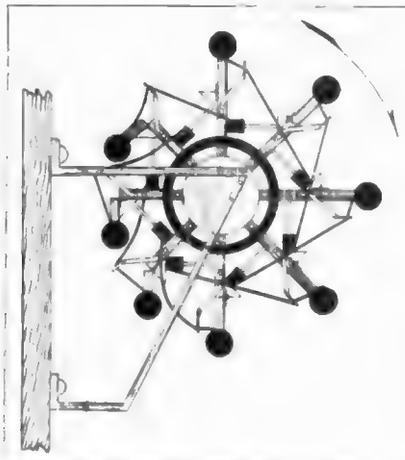


Fig. 6—At the Left is an Old Type of Perpetual Motion Machine Brought up to Date by a Noted Inventor. This is Another Wild Chase After the Goose That Laid the Golden Eggs.

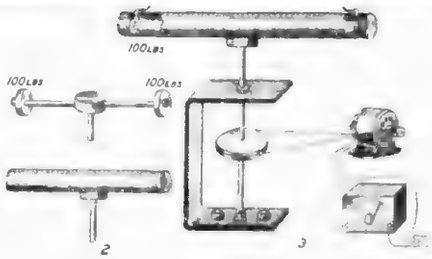


Fig. 7—Above is Illustrated a Device Which is Supposed to "Produce Power" from Centrifugal Force. The Claim Being that no More Power is Used up in Driving Weights Stationary Upon an Axle Than if Those Weights Were Free to Move in a Tube.

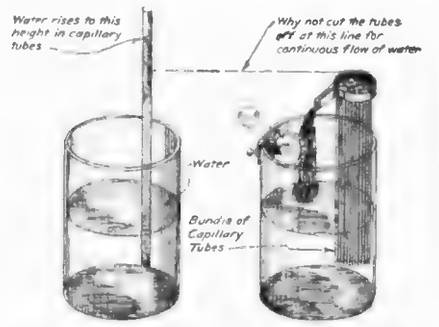

Water rises to this height in capillary tubes
Why not cut the tubes off at this line for continuous flow of water
Water
Bundle of Capillary Tubes

Fig. 8—Capillary Motors of this Nature Never Work for the Reason that Regardless of How High the Water May Rise in the Small Tube, it Never Flows Over the Top.

Some New Perpetual Motion Systems

The *Patent Advice* Department of this publication receives hundreds of plans every year on perpetual motion systems, or attempts at perpetual motion. Sometimes it is very difficult to explain these; at other times rather simple. From Walter T. Williams, comes a photograph of a perpetual motion device seen in the window of a small shop in Cincinnati. Mr. Williams asks how this device operates. Two magnets are arranged near the base of a clock, as shown in the accompanying photograph (Fig. 4.) To the pendulum of the clock, two other magnets are fastened. Wires leading from the permanent magnets, secured to the screws holding them in place, pass into a bottle filled with a peculiar pink colored liquid. "That at least a mild electric current is generated, is indicated by the fact that the electrolytic action has set up a deposit at the points where the wires are attached to the magnets," writes Mr. Williams, who further states that "the inventor is very secretive, and declines to offer a full explanation of the device."

It is evident that the installation is a fraud on the very face of it. In the first place, two bare wires in a pinkish colored solution, both being of copper, will never generate electric current, sufficient to drive a clock. In the second place, attaching wires to permanent magnets has absolutely no effect on the magnets. In the third place, the attraction and the repulsion of permanent magnets is generally equal, and, therefore, the pull being the same on both sides of the pendulum, and there being no shield for magnetic lines of force, the pendulum of a clock, if it depended on the magnetic properties of the iron, would stand stock still.

This magnetic device brings forth a construction of a magnetic motor of unusual interest (Fig. 5). This device was invented in the early part of the 19th century. Two permanent magnets are mounted in a frame, so that they are free to revolve. Pulley-wheels attach to the axles upon which they are mounted, communicate with other pulleys above. Suspended between the two revolving magnets is another magnet, which is free to swing from side to side, and which is connected to the pulley wheels by means of levers. The action of the device is supposed to be as follows: The tumbler shown at the top of the picture as a round black ball, remains in this position until the perpendicular magnet is attracted to one revolving magnet, being repelled by the other. At this point, the tumbler falls over, rotates the wheel on top one quarter of a revolution, causing the revolving permanent magnets to swing through an arc of 180 degrees, presenting, therefore, their opposite faces toward the swinging or pendulum magnet, consequently, reversing the direction of attraction. The device is therefore supposed to operate continuously, but it doesn't!

Mr. James W. Kennedy of Malone, N. Y., has forwarded a quantity of patents issued to him. Amongst these are inventions of perpetual motion devices. The one illustrated here (Fig 6), is one of five different devices. Its action is as follows. A series of weights, slide on rods, which when sliding downward as shown lift weights, on their hinges. Inasmuch as the weights on the right hand side of the diagram are further from the center than weights on the left side of the diagram, the inventor has assumed that the device will continue to operate perpetually. With perhaps a few very slight changes, it is identical with the device invented by James Ferguson in 1770. Ferguson at that time stated that he had shown the device to many of his friends, several of whom built it, and he states that in no case did it work. The fact that this machine will not work is self-evident.

An ingenious device was forwarded by H. D. Dibble of Cardwell, Montana; this is shown in Fig. 7. Mr. Dibble says, "suppose that we have on the end of a cross arm two weights 24 inches apart, each weighing 100 lbs. Rotating these weights at 650 revolutions per minute, let us put 29,040 foot pounds of energy into the device. If this device is now permitted to run as a fly wheel until it comes to rest, we get back exactly 29,040 foot pounds of energy, omitting frictional losses.

Suppose that instead of placing these weights on the end of an arm, we mount them in a frictionless tube. These weights are free to slide in this tube, and are started at the center of the wheel. As the tube is rotated rapidly, centrifugal forces drive the weights toward the end of their stroke, compressing at the same time the air in those cylinders. Catches now lock these weights into place and according to the inventor, we get back exactly 29,040 foot pounds of energy, the same as in the above case. The air in these end spaces is, therefore, compressed to 100 pounds per square inch, and if tapped, will deliver 4,382 foot pounds of additional energy. Let us even assume that the compressed air which we receive from the ends of the cylinders, will deliver 4,382 foot pounds of energy. Where did this energy come from? It is very simple to explain. It was delivered to the fly wheel before the fly wheel had come up to its proper momentum. The motor driving that cylinder exerted power to drive it. It exerted power when the weights were within 2 or 3 inches of the center. Centrifugal force then acting upon the weights, gradually drove them to the outside, but in doing so, the force that was originally given to the fly wheel was not the same as in "case 1." A greater amount of energy sufficient to drive these weights outward against the air column was necessary. Weights near the center are much easier to rotate than those near the perifery, and it is a good deal more difficult to drive weights toward the perifery against an air column, than if no air column were present. Consequently, Mr. Dibble's idea of developing 1,400,000 horsepower per hour for nothing is absurd.

Interesting forms of attempts at perpetual motion are the *capilliary systems* in which thin tubes are inserted into water, and the water rising in these tubes presumably, flows over the top and operates a water wheel (Fig 8.) If the many inventors who forward these suggestions would only try this system, they will find that the water will not flow out of the top of the tube.

For once and for all let us state that perpetual motion is an impossibility, and that inventors of these devices are either stupidly following false ideas or knowingly attempting to defraud the public.

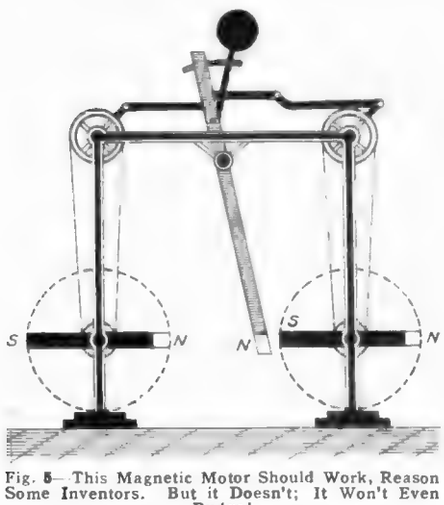


Fig. 5—This Magnetic Motor Should Work, Reason Some Inventors. But it Doesn't; It Won't Even Budge!

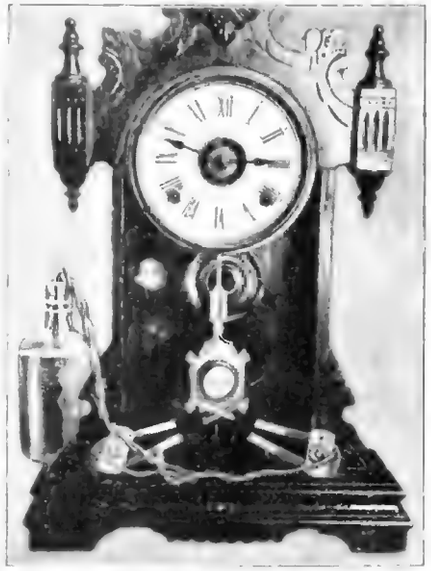
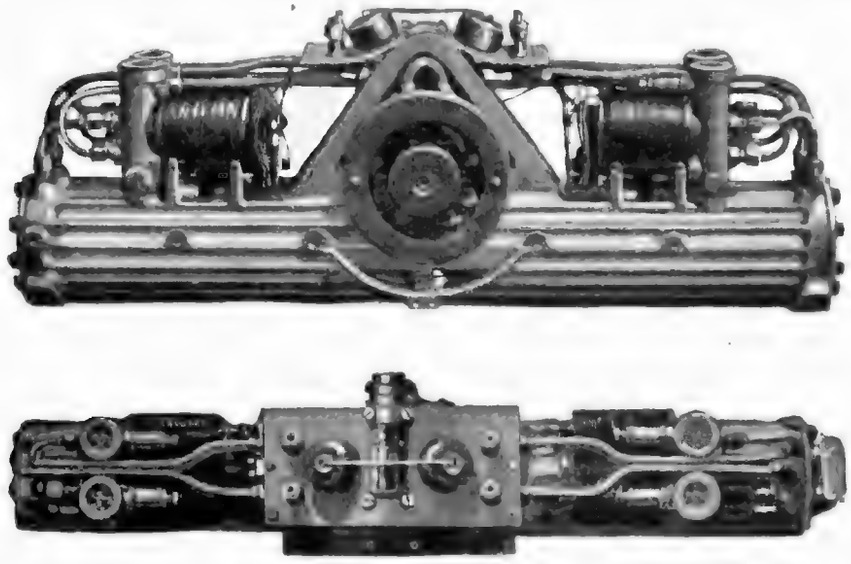


Fig. 4—The Electro-Magnetic "Perpetual Motion" Clock Shown Above is an Absolute Absurdity, and Will Probably Run When the Cow Leaps Over the Moon Again.

Automatic Pilot for Aircraft

By G. H. DALY, D. S. M.

AN invention in the stabilizing of airplanes has just been tried and proved a success on the London, Paris and Amsterdam Lines. It is for maintaining the equilibrium of an airplane automatically without the aid of a pilot and is known as the Aveline Stabilizer, after its inventor, M. Aveline.



Picture Herewith Shows the Compressed Air Controlled Cylinders and Pistons Used in the Automatic Airplane Stabilizer Recently Tried Out Successfully in England. The Valves are Opened and Closed Through the Air Cylinders by Means of Electro-Magnets as Shown, These Magnets Having Their Circuits Controlled by an Automatic Mercury Switch, Shown More in Detail in the Diagram Below.

When driving an automobile you are doing two things—steering it and controlling the speed of the engine. But an airplane pilot not only does these two things, but he has also to balance his craft; that is, keep it on a level longitudinally and control its lateral inclination, or, in other words, preserve its equilibrium. This balancing arrangement has always been one of the difficulties and dangers in flying.

At present an airplane pilot maintains the equilibrium of his machine by means of two factors: 1. The ailerons and 2. the elevator.

Anyone who has seen an airplane at close quarters will have noticed that portions of the wings are flexible or that small movable wings are provided. These movable wings are called *ailerons* and are used for balancing the 'plane laterally, that is, they keep the machine from rocking from side to side and keep the wings on a level or allow one wing to fall lower than the other so as to bank the machine.

The *elevator* is the movable horizontal plane fixed to the tail of an airplane—it is intended to keep the machine on a level keel longitudinally if required or to point the head upwards or downwards as needed.

What the Aveline stabilizer does then is to control the ailerons and elevator without the aid of a pilot, to secure a level straight course.

The stabilizer is in two parts; one part controls the rudder and the other the elevator. As however, the part for controlling the elevator is practically the same as that for the ailerons, only the latter part will be dealt with here.

In the first place, the stabilizer comprises an *inclinometer*. This is a round fibre disc in which is a narrow circular groove, half filled with mercury.

In this circular groove two electric contacts are fixed, each at a short distance above the level of the mercury on both sides. A third contact is fixed in the bottom of this circular groove, in permanent connection with the mercury. These three contacts are connected to a 4-volt battery, thus forming two 4-volt circuits. These two circuits are called, respectively, the right and left hand 4-volt circuits.

Now if the fibre disc is tilted, the mercury will rise in one side of the circular groove and make connection between one of the contacts on the side of the groove and the bottom contact. Therefore, one of the 4-volt circuits is closed.

In each 4-volt circuit there is a solenoid switch, so that when one of the circuits is closed, a solenoid switch is brought into action and closes a stronger relay circuit of 12 volts.

The 12-volt circuit on being closed operates —by means of another solenoid switch—the inlet and exhaust valves of a cylinder which is supplied with air from an air container.

A pressure of air at fifty pounds to the square inch is maintained in this air container by means of two wind-driven turbine pumps.

Suppose the airplane tilts to the left—that is, the left wing is lower than the right. The mercury will rise in the left hand side of the disc and will make contact in the left hand 4-volt circuit.

This closes the left hand 12-volt circuit which, by means of the solenoid switch, opens the inlet valve and closes an exhaust valve, thus air from the air container rushes in. The cylinder contains a piston and the rush of air forces this piston away from the top of the cylinder, that is, to the right hand.

Attached to the piston is a rigid connecting rod provided with a rack which engages with the teeth of a quadrant. It will be seen, therefore, that the quadrant will be moved to the right. Attached to the quadrant are the wires which control the ailerons and as the quadrant is moved to the right, the left hand aileron or wing flap will be pulled down and the airplane automatically righted.

If the 'plane tilts to the right instead of the left, the reverse takes place, for on studying the diagram it will be seen that the left and right hand arrangement applies to everything, or all parts are duplicated.

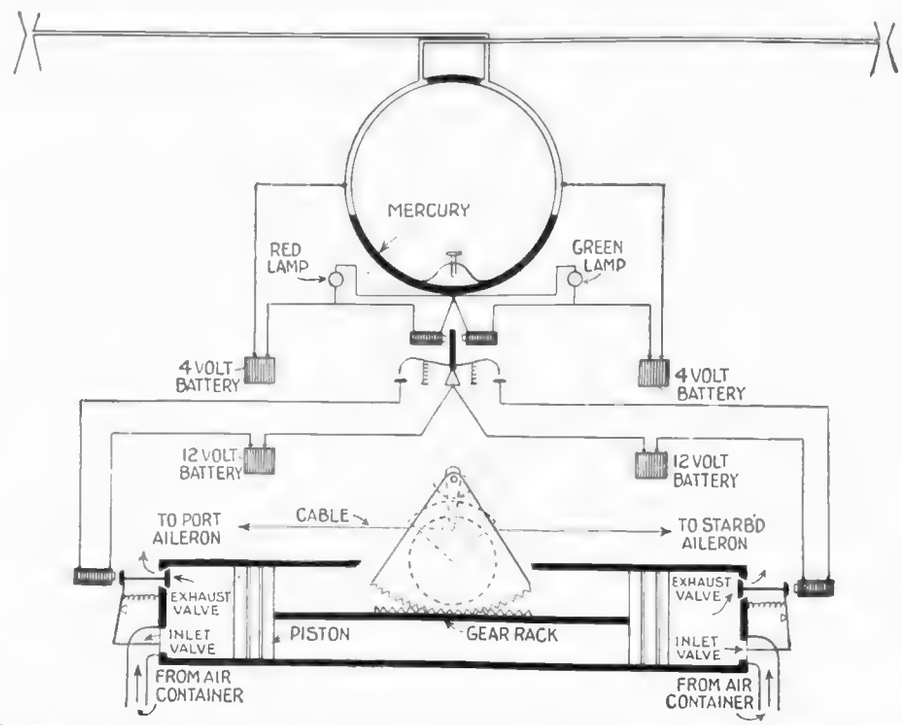
Sometimes, however, an airplane does a flat turn, that is, it turns to the right or left without throwing the machine off its lateral keel. In this case centrifugal force would send the mercury up in one side of the groove and the stabilizer would act as though it had tilted, when really it was perfectly level.

M. Aveline has counteracted this by letting the pressure of air, as the machine is traveling along, play upon the two surfaces of mercury in the groove.

This is done by means of two pipes which run from the groove in the fibre disc to the left and right hand wing tips of the airplane.

The ends of these pipes are open at the wing tips to receive the air pressure.

(*Continued on page 379*)



This Diagram Shows How the Aveline Stabilizer is Connected With the Automatic Mercury Switch. As the Airplane Tends to Tip Sidewise, the Rush of Air Through the Venturi Tubes at Right or Left Causes More or Less Pressure on the Mercury Within the Tube, so That it Rises or Falls Accordingly. The Pilot Lamps and Also the Circuits Through the Two Control Magnets Just Under the Mercury Switch are Accordingly Excited.

Seaplaning from Florida in Record Time

SEAPLANE
9 HRS. 56 MIN.
121 MI. PER HR.
1210 MI.
PALM BEACH
1210 MI. TO NEW YORK
STEAMER 72 HRS 16½ MI. PER HR.
TRAIN 60 HRS. 20 MI. PER HR.
AUTO 30 HRS 40 MI. PER HR.
© 1922 BY SCIENCE AND INVENTION

An Airplane Recently Flew from Palm Beach, Florida, to New York City in the Record Time of Nine Hours, Fifty-Six Minutes Over the 1,210 Miles. This Trip Requires Sixty Hours by Rail, and at Least Seventy-Two Hours by Coastwise Steamer. An Automobile Might Make the Trip in Thirty Hours if a Speed of Forty Miles an Hour Could be Kept Up, Which is Doubtful, on Account of the Different Kinds of Roads and Detours Encountered on Such a 1,210-Mile Trip.

ALOENING seaplane piloted by Clifford L. Webster and Fred R. Golder, smashed all records for automobiles, railroad trains, and coastwise steamships recently, when the remarkable speed record was made of nine hours and fifty-six minutes actual flying time for the span of twelve hundred and ten miles, separating the two cities. The seaplane was en route eleven hours and sixteen minutes, a stop of one hour and twenty minutes having been made.

Thousands of American tourists have made the trip between northern cities and the Florida resorts by rail, and no doubt they thought that they were traveling at a good rate of speed on the trip between the two climes, but the railroad time from Palm Beach to New York City is sixty hours. At this rate, the train's average speed is about twenty miles per hour. Compare this with the seaplane record.

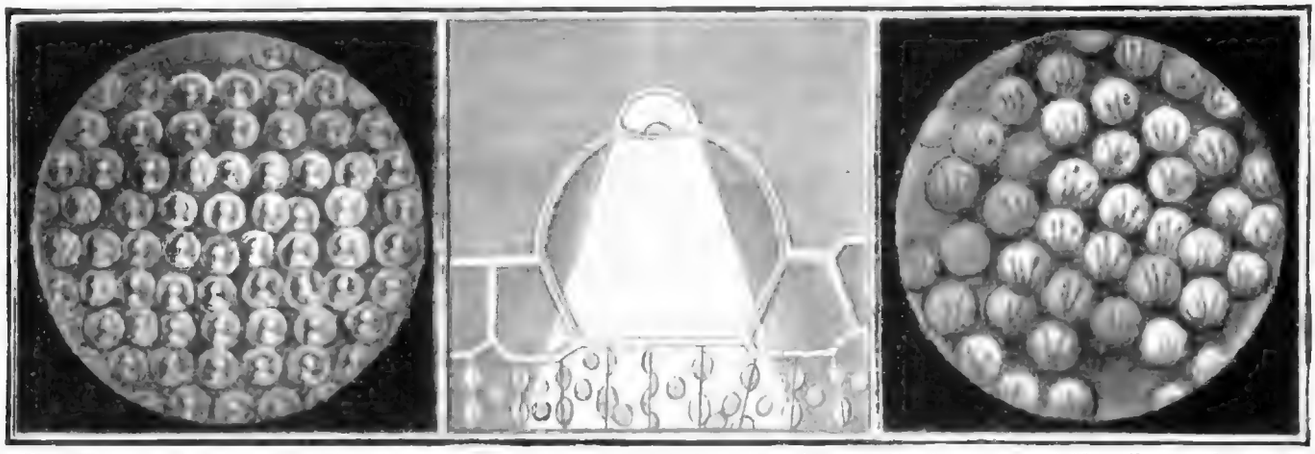
(*Continued on page 376*)

The Eyes of Plants

FOR many years the expression "eyes of plants" has been used. There is no doubt that these drawings are puzzling. As man has constituted himself the standard of measurements of all things, that is to say, he compares everything to himself, many people have come to the conclusion that plants, resembling mankind, have their sensations, their feeling, their conscience, and even understanding, comparable in character to that of man himself. The discussion of this need not be long. Unfortunately the text that accompanies photographs such as these, is used to confirm these false theories; it is written up to prove the case. It is our duty to describe such pictures in their true meaning.

If anyone stands in front of a showcase of photographic apparatus, and looks at the many cameras which are there displayed, he would never for a moment imagine that he was looking at that number of eyes, and yet it is clear that if the shutter of the apparatus was open, every apparatus would show upon the ground glass its own picture. But it is perfectly immaterial whether the picture is there or

(*Continued on page 380*)



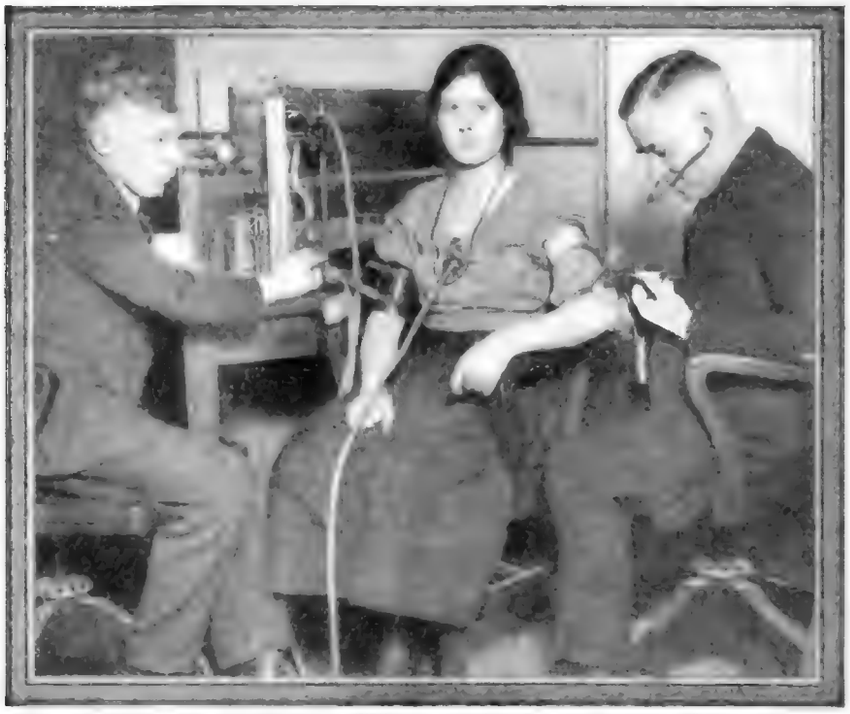
A Micro-Photograph of a Portrait Taken Through the Lenses Found in the Leaf of a Plant. Micro-Photographs of this Nature Have Given Rise to the Erroneous Impression that Plants Actually "See."

Above is Shown One of the Lenses Found in the Leaf of a Plant. The Lens Formation on Top Directs the Light, the Lower Further Increasing the Concentration so as to Assist the Plant in the Development of Chlorophyll.

The Images Formed Mean Nothing More to the Plant Than the Image on the Ground Glass of the Camera Does to the Camera. The Lenses Do, However, Serve a Natural Necessity Which Assists the Plant in its Life and Reproduction.

Truth Enforced by Machine

By P. E. SCHREINER



"The Truth, the Whole Truth, and Nothing but the Truth," as Roosevelt Said, and that is What We May Expect in All Private and Court Investigations Hereafter, for Thanks to this New "Lie Detector," any Hesitancy on the Part of the Witness is Instantly Detected by a Change in Blood Pressure as Well as in the Breathing and Rate of Heart Beat. Oh, Yes, We Almost Forgot to Explain that the Young Lady in the Picture is Thoroughly Innocent, and Simply Posed for this Photo to Illustrate the Machine in Actual Use.

WIVES cannot deceive their husbands any more, if each home has one of these truth machines installed, a scientific tell-tale which was invented by John A. Larson, Ph.D., A. B., and M. A., a graduate of the University of California and of the Boston University in psychology.

Larson came to Berkeley from the University of Boston to teach at the University of California. While here he became interested in the so-called Marston Deception Test and was prevailed upon by Chief Vollmer of the Berkeley Police Department to see if he could not modify the same and adapt it to police uses.

A brief resumé of the Marston test is as follows:

The changes in the systolic blood pressure which are produced by emotional disturbances are recorded. The first and very common psychology test is the so-called "Association Test." The second is the galvanometric test and the third is the physiological. In his work Marston considered all methods, but later dispensed with all except that of the blood pressure. The Association test is often cumbersome and difficult to interpret and not very satisfactory for presentation before courts. The second method, that in which the galvanometer is used, is also not utilized easily. The primary difficulty experienced is in the instrument. If proper use of the galvanometer is made, the results are highly satisfactory and important.

In Larson's work, the aim is to eliminate all the variables possible. Thus, if for no other reason than to determine the effect of respiration upon the heart rate,

(*Continued on page 378*)

Tone Producer for String Musical Instruments

By ALEXANDER H. KOLBE

A TONE producer, designed to improve and increase the tonal quality of all string musical instruments, has just been invented. The device is made of specially prepared wood so constructed that it conforms with the shape of the instrument in which it is to be used. With the aid of this tone producer the modern manufacturer of violins, violas and 'cellos is enabled to put into his instruments some of the extraordinary tone quality so highly prized in the old Italian instruments of Stradivarius, Guarnerius, Amati and the other famous luthiers of Italy's golden days of string instrument making. With the passing of these famous makers their art has been lost. In recent years there have been numerous attempts on the part of makers of stringed instruments to reproduce the tonal quality found in the creations of the old masters. Now the inventors of the tone producer have brought the glow of life into the violin, according to famous violinists who have tried it.

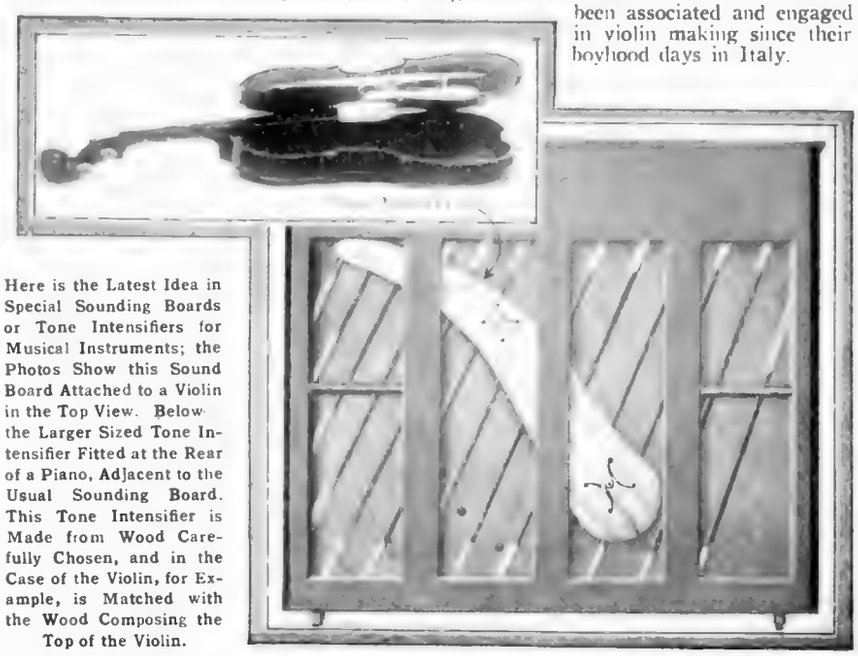
The tone producer is very simply constructed. It is inserted under the top of the violin after it has been opened, as shown in the accompanying illustration. The top of the violin is then secured and the increased volume and sweetness of tone is recognized immediately. The wood from which this device is made is carefully chosen and is matched with the wood composing the top of the violin. The tone producer is scientifically constructed after extensive experiments in matters of acoustics and effects of different woods.

The stimulation which this device affords is not confined to the most expensive instruments. It can be applied with equally good results to an ordinary, cheap instrument of the variety commonly used by students.

Tests conducted by the inventors show that the device gives increased tonal quality to the stringed instruments of the orchestra and makes it possible for the leader either to reduce the number of strings employed or to increase the number of wood-wind and brass instruments. It was found that the device when used in a violin for recording phonograph records brought out to the best advantage the sweet tones of the violin on the record.

The tone producer greatly enlarged may also be used to good advantage in a piano or player-piano to increase the volume and richness of their tones.

Violinists who have heard and tried violins equipped with this device and praise it are Kreisler, Heifetz, Thibaud, Spalding, Betti and Casals. The inventors have been associated and engaged in violin making since their boyhood days in Italy.



Here is the Latest Idea in Special Sounding Boards or Tone Intensifiers for Musical Instruments; the Photos Show this Sound Board Attached to a Violin in the Top View. Below the Larger Sized Tone Intensifier Fitted at the Rear of a Piano, Adjacent to the Usual Sounding Board. This Tone Intensifier is Made from Wood Carefully Chosen, and in the Case of the Violin, for Example, is Matched with the Wood Composing the Top of the Violin.

New "Cold Light" For Movies

By EDWIN HAYNES

AN instrument for the production of a *cold light* was recently demonstrated in Los Angeles, to a group of scientists and others, including William Dresher, President of the Bausch & Lomb Optical Company, of Rochester, New York, the largest manufacturers of lenses in this country.

The inventor of this device, M. J. Ritterrath, has devoted himself to physical research ever since his graduation from a German University, and has devised several optical instruments which have proved their utility in practice. It required four years of arduous labor to develop his last invention, which he regards as his most important achievement.

Technical details are not yet available, other than that the new light is obtained by filtering or straining out the infra-red rays of ordinary light. The passing of a continuous stream of water through the filter is a part of the operation. As a result of the filtering process a purer white light is obtained, which having been deprived of heat can be applied to many uses for which ordinary light is not available.

Scientific interest attaches to the instrument chiefly because of the fact that the elimination of heat from a strong light will enable the biologist to greatly extend his researches in a great field—the de-

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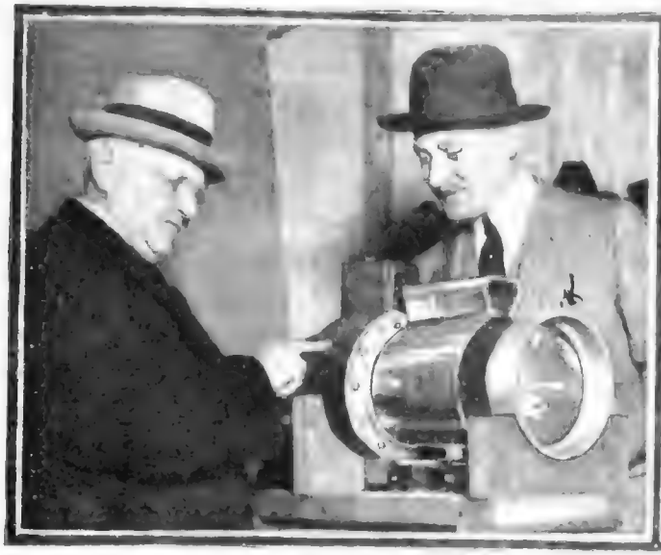
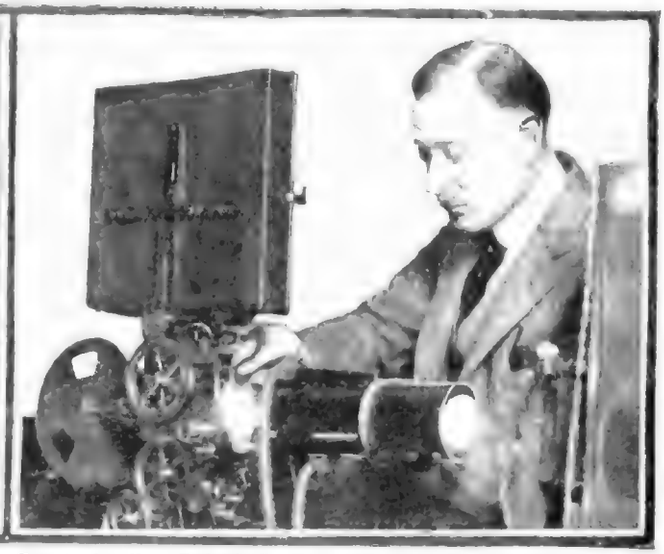
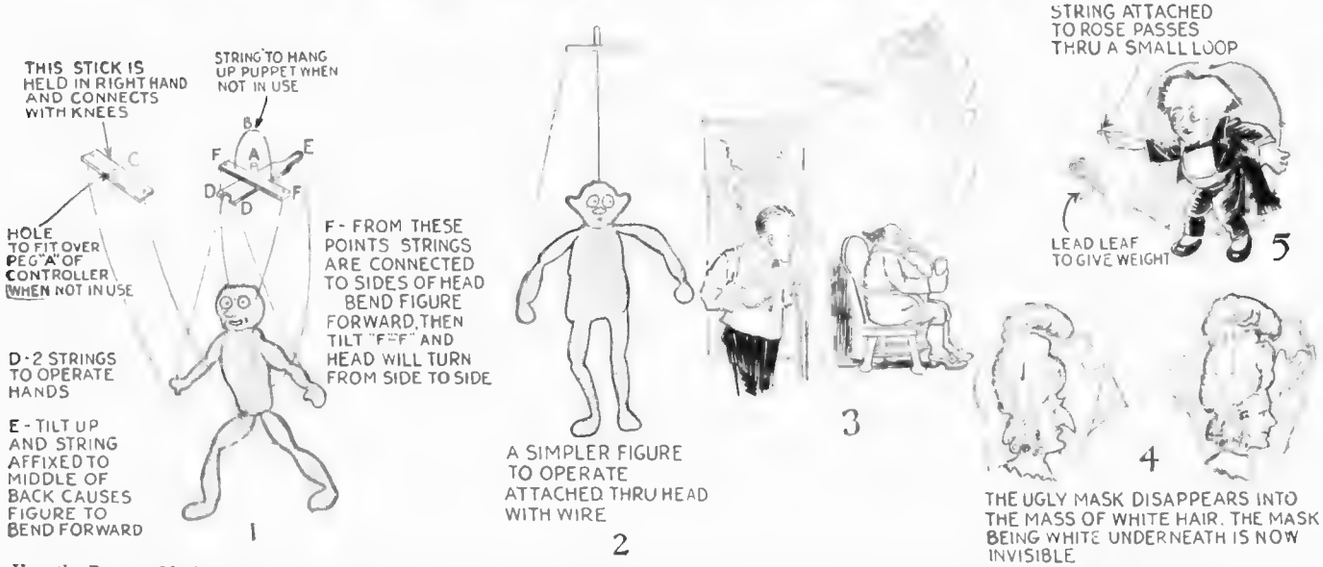


New "Cold Light" for Motion Picture and Stereopticon Projectors Uses But 6 Amperes Instead of 75 Amperes, as Do the Ordinary "Movie" Projectors. This Light Will Not Burn the Film No Matter How Long it is Left to Act and Will Save Cracked Lenses. The Inventor, M. J. Ritterrath, is Seen at Right.



Experts Are Very Enthusiastic About the New Ritterrath Cold Light for "Movie" Projectors. The Light is Pure White in Color, and Highly Inflammable "Movie" Film Can be Subjected to it for Hours Without Burning. Mr. Ritterrath is Shown Holding a Piece of Film Against the Light.

Tony Sarg's Marionettes


THIS STICK IS HELD IN RIGHT HAND AND CONNECTS WITH KNEES
STRING TO HANG UP PUPPET WHEN NOT IN USE
HOLE TO FIT OVER PEG "A" OF CONTROLLER WHEN NOT IN USE
D-2 STRINGS TO OPERATE HANDS
E-TILT UP AND STRING AFFIXED TO MIDDLE OF BACK CAUSES FIGURE TO BEND FORWARD
F-FROM THESE POINTS STRINGS ARE CONNECTED TO SIDES OF HEAD BEND FIGURE FORWARD, THEN TILT "E-E" AND HEAD WILL TURN FROM SIDE TO SIDE
1
A SIMPLER FIGURE TO OPERATE ATTACHED THRU HEAD WITH WIRE
2
3
STRING ATTACHED TO ROSE PASSES THRU A SMALL LOOP
LEAD LEAF TO GIVE WEIGHT
5
4
THE UGLY MASK DISAPPEARS INTO THE MASS OF WHITE HAIR. THE MASK BEING WHITE UNDERNEATH IS NOW INVISIBLE

How the Famous Marionettes Built by Mr. Tony Sarg Are Operated Becomes Clear From the Drawings Herewith. The Method of Operating a Simple Figure so as to Make it Walk, Sit Down, et cetera, is Shown at the Left. A Still Simpler Figure to be Operated by Wires and Strings, is Shown at Fig. 2. Fig. 3 Shows How a Dummy is Made to Smoke, and When Figure is Removed from Chair, Tube Separates, Thus Keeping the Trick Secret. Fig. 4 Shows How Quick Change of Marionette's Face is Accomplished, and Fig. 5 Shows How a Figure Picks Up a Rose.

TONY SARG, now of New York, but formerly of England and the Continent, is probably best known for his Marionettes, or animated stage figures which he creates, paints and wires up himself. Mr. Sarg's studio and workshop in New York City, is on West 9th Street, in what is generally known as the Bohemian section, where many well-known artists have their studios. A fantastic little door-plate, designed by the artist himself, announces that it is the home of *Tony Sarg's Marionettes*. An entrancing little story telling all about Mr. Sarg and his wonderful actors made of wood and sawdust has been woven into book form by F. J. McIsaac, with illustrations by Tony Sarg himself.

Grown-ups and juveniles alike, no doubt, have often thought that they would like to build a miniature theatre and try out scenic effects of their own conception, not to mention the production of miniature plays. The accompanying illustration shows how a number of Mr. Sarg's marionette effects are produced. Fig. 1 of the accompanying picture shows how the wooden parts, as well as the strings com-

(*Continued on page 377*)

What Is Paper Made Of?

THE basic materials in printing papers are wood pulp and rags. Wood pulp usually comes to the paper mill in quilt-like sheets ready to be dumped in the beaters. Very fine paper is now being manufactured from wood pulp stock—but the strongest and most beautiful papers are still made largely from rag stock.

Huge bales of rags are opened in the mill—renovated by means of a dusting machine—then sent to the sorting room where experienced women remove such foreign objects as buttons, hooks and eyes—and separate silk, wool, elastic, and so on from the linen and cotton goods. All cotton and linen materials are graded for different qualities of paper.

The rags are then shredded and dumped into a steel cooker or digester where they are treated with live steam and chemicals to remove color and impurities. Upon being dumped from the digesters or cookers, rags are taken to the beaters—where the various ingredients for making paper are assembled.

These powerful beaters mix the raw product with bleach, color, sizing and so on. A series of revolving and stationary knives thoroughly disintegrate the stock—soften and spread the fibers. The length of the "beating operation" depends upon the paper being made.

After this process the pulp is thinned to a liquid over 90 per cent. water. It then comes to the *wet end* of the paper machine. Here it passes out over the *wire* - which is an endless copper screen constantly being vibrated to interlace the fibres firmly and uniformly.

As the stock passes along the wire, some of the water escapes thru the perforations and much of the water is sucked out by compressed air as the wire passes over a suction box.

The *dandy roll* is a brass screened cylinder extending across the entire width of the *wire*. The axis is held in perpendicular grooves, permitting the entire weight of the dandy roll to come in direct contact with the partly dry pulp on the wire. Just before the wet sheet leaves the wire it passes under the dandy roll, so that the water mark design, several copies of which are built in multiples on the face of the screen, leaves its imprints upon the paper.

As the stock travels over and under two long napped pure wool *felts* any slight traces of the screen pattern are brushed out, leaving only a greater density of texture where the water marks have been imprinted.

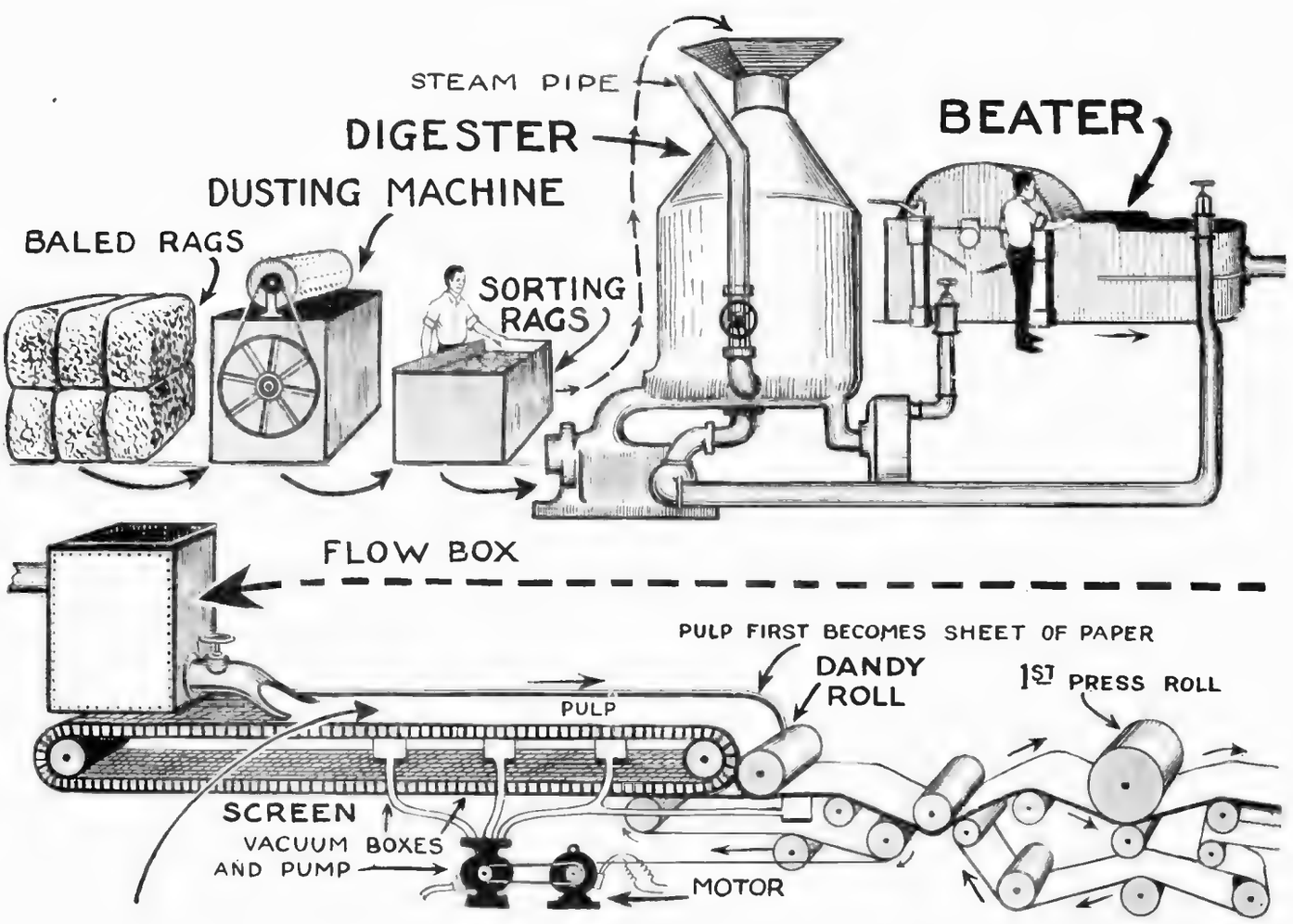
The paper then passes thru a series of from twelve to fifty steam heated, hollow steel cylinders. As it passes thru these dryers it is held smooth and tight by canvas belts. A wet sheet of fibre that will scarcely sustain its own weight here becomes strong paper.

Machine finish book papers are finished right on the paper making machine by means of cylinders or *stacks*. When paper is not to be finished on the paper making machine it is run thru a limited number of calendar rolls and then wound up.

The body of most coating on paper is pure white silky clay. Casein is mixed with the body of clay and this is colored and diluted to about the consistency of smooth cream. This liquid is then taken to the coating machines which automatically spread it uniformly over the surface of the paper. This spreading is done with long, soft-haired brushes which are continually moving back and forth. Paper is fed into the coating machine directly from the roll as it comes from the paper machine.

After applying the enamel, paper is mechanically draped in festoons and carried back where hot air is blown between the sheets. By the time it reaches the rewinder its coating is perfectly dry and firmly set.

After being rewound this roughly finished paper—which feels very much like a blotter—is *super calendered* to bring out the smooth, rich beauty of the clay finish. The super calendering machine is a *stack* of rolls run by contact with the lower roller which is operated by power. Because of this friction contact the rollers slightly decrease in speed from bottom to top, permitting just enough friction—together with the tremendous weight of the



Wood Pulp or Rag Mixture, which is about 90 Per Cent. Water, Feeds out of the Flow Box Thru Slits and is Carried Along on the Moving Wire Screen as Shown. On Its Travel Toward the Dandy Roll, the Moisture is Removed from the Pulp Mixture by Vacuum Boxes Placed Under the Traveling Screen, which Boxes are Connected to a Vacuum Pump in the Manner Shown. The Paper, which is Crude and Thick at First, Passes on Thru the Dandy Roll, Thence to the First and Second Press Rolls, Carried by Continuous Traveling Belts, the Paper Becoming Thinner and "Tighter" Progressively.

rolls—to produce a glossy, hard finish where the rough coating has been applied.

The degree of finish is determined by adjustment of leverage weight.

Medium grade uncoated book papers are often "supered" on the *super calender* in much the same way as coated paper is finished, the difference being that on the uncoated paper the sheet comes in contact with steam before passing thru the rolls.

Before referring to the final process in paper making, we will digress to state that strength, hardness, color and crackle in bond paper are not alone due to the rag stock. A rag sheet with no sizing is almost as soft and absorbent as a piece of old cloth. *Hard sizing* is required to give this sheet sufficient stiffness. Most sizing is a chemical mixture consisting largely of rosin. The better grades of bonds are almost entirely made from rag stock altho wonderful results are now being secured with an all-sulphite pulp. The rag sheet is tougher—more enduring.

After the paper has been finished the rolls are then loaded on a series of horses or trestle work. Often as many as ten rolls are simultaneously fed into one cutter. A horizontal knife is bolted into a revolving cylinder which at every revolution strikes the stationary knife below. The length of a sheet is determined by the speed of the revolving knife and the speed with which the paper is drawn thru the cutter. Endless strips of revolving canvas carry the sheets to *sorting tables* where *cutter girls* pile it neatly and sort out torn and defective sheets.

All coated papers are hand sorted—blemished sheets thrown out, seconds put in one pile and first-class paper piled on the other side of the sorter. Sheets to be trimmed are taken from the cutter to the trimmer. All coated sheets are trimmed. If large sheets are to be cut into numerous smaller ones on the trimmer, the counting is done before being cut into smaller sizes. Girls become so skilful that they can count a ream in about two minutes.

Could You Answer These Questions?

By W. A. KIMBALL

1. After physical exercise one feels very warm. Is the body temperature any higher?

No. The body temperature remains the same, 98.4° F., which is normal, due to the fact that the perspiration evaporating from its surface cools the body sufficiently to keep it at the same normal temperature.

2. Why don't ponds and lakes freeze solid?

Water is densest at four degrees, 4° above the freezing point and it sinks to the bottom while the top layer freezes.

3. After the sun has been shining upon the window pane for a long time is the glass warm?

Only a little warmer than the air, because transparent objects transmit the heat waves and absorb little heat.

4. What makes some fireplace wood snap more than others?

Wood that contains more sap in its cell structure, snaps most because the moisture expands to steam, due to heat, and causes an explosion.

5. Steam and boiling water are both of the same temperature, 100° C., but a burn from steam is more severe.

A gram of boiling water contains 100 calories of heat while a gram of steam contains 540 calories, over five times as much heat.

6. Did you know that the compass needle does not point to the North Pole, recently discovered by Peary?

All compasses (point) to the magnetic pole near Hudson Bay where there is, for some reason, the greatest magnetic attraction, probably due to the distribution of magnetic material beneath the surface of the earth.

7. Did you know that battleships are never built on ways that point north or south?

The hammering of the metal magnetizes it more if the ship is in a north and south position, and this would seriously affect the compass needle. The ships are placed east and west and this neutralizes the magnetic effect of hammering the metal.

8. Why can birds alight upon electric wires and not get a shock?

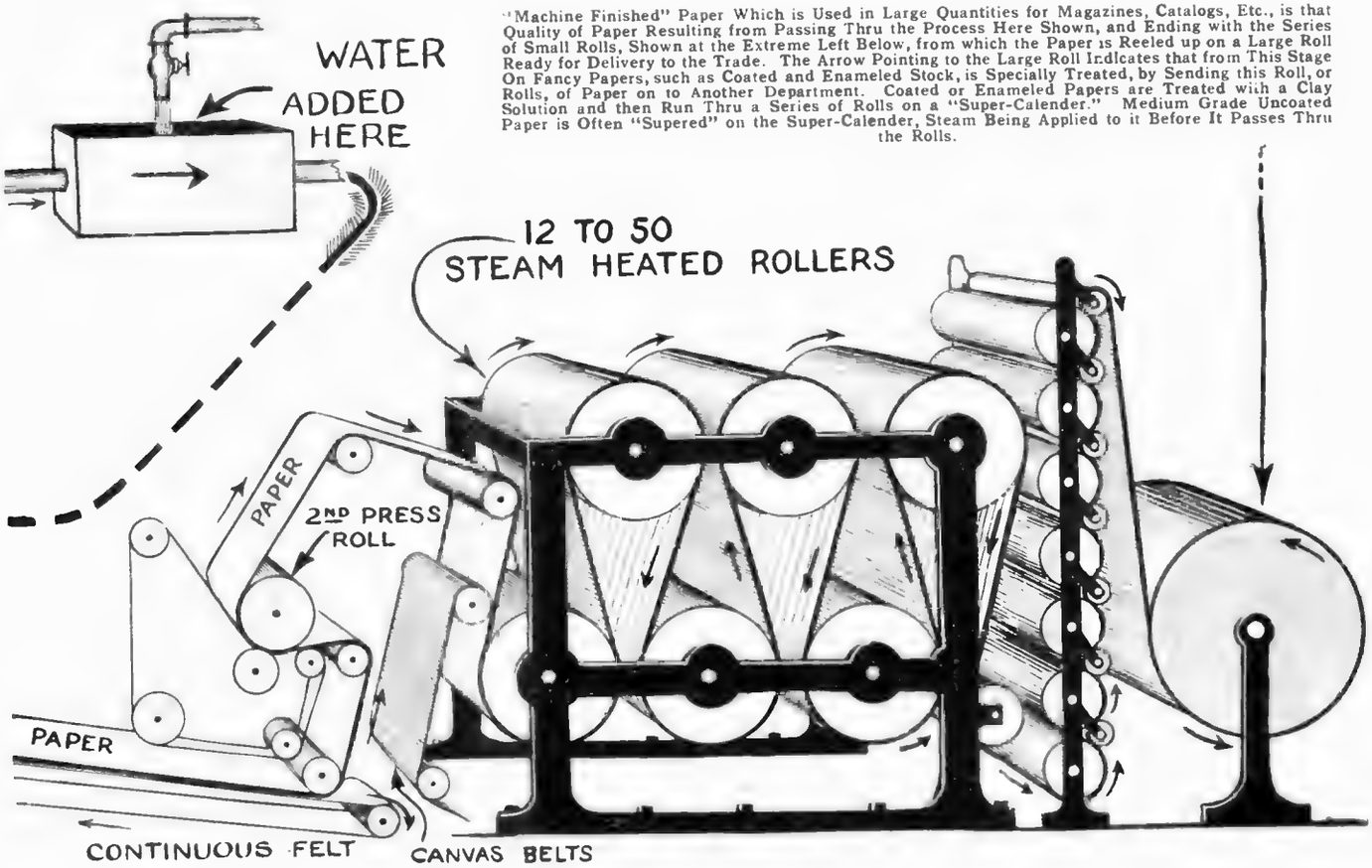
They do not complete the circuit with both feet upon the same wire. If any part of their body touched another object that was a conductor of electricity while they were on a wire, the circuit would be completed and the electricity would pass thru their bodies.

9. Why do thick glass tumblers crack more often in hot water than thin tumblers?

Thick glass requires more time for the heat to pass thru and one side expands, due to heat, before the other side, causing the glass to crack. Thin tumblers expand more evenly and do not crack.

10. As steel expands when heated, and as we also know that steel track rails expand greatly from the sun's heat in the summer time, why is it that the rails do not buckle up and twist due to this expansion?

The rails do expand quite considerably and this action is provided for by allowing a gap of one-half inch or less between the lengths, where they are bolted together. It is not feasible to electrically weld rails where they are exposed, but when set in concrete or paving blocks the heat is dissipated sufficiently fast to permit of this.



"Machine Finished" Paper Which is Used in Large Quantities for Magazines, Catalogs, Etc., is that Quality of Paper Resulting from Passing Thru the Process Here Shown, and Ending with the Series of Small Rolls, Shown at the Extreme Left Below, from which the Paper is Reeled up on a Large Roll Ready for Delivery to the Trade. The Arrow Pointing to the Large Roll Indicates that from This Stage On Fancy Papers, such as Coated and Enameled Stock, is Specially Treated, by Sending this Roll, or Rolls, of Paper on to Another Department. Coated or Enameled Papers are Treated with a Clay Solution and then Run Thru a Series of Rolls on a "Super-Calender." Medium Grade Uncoated Paper is Often "Supered" on the Super-Calender, Steam Being Applied to it Before It Passes Thru the Rolls.

MOTOR HINTS

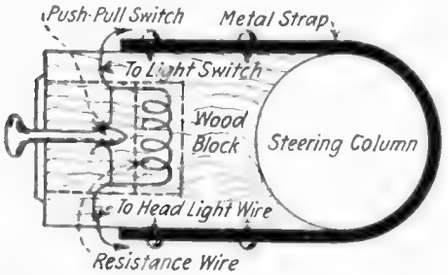
First Prize, $25.00

A HANDY HEADLIGHT DIMMER

All motorists know how troublesome it is while driving along a well-traveled road at night to have to reach down to the dash in order to dim their lights when approaching other cars.

This trouble may be overcome by mounting a switch on the steering column, as shown in the illustration.

A resistance coil of a size suitable to dim the lights is wound, and is mounted together



Mount Your Dimmer Switch on the Steering Column and Avoid Accidents Due to Inaccessible Switches.

with a push-pull switch in a wooden block, which in turn is clamped to the steering column. When the switch is pushed in, the resistance is short-circuited, and the lights burn brightly. When it is pulled out the resistance is thrown in series with the headlights and they are dimmed.

To connect this dimmer remove one of the headlight wires from the light switch, and connect to one side of the resistance. Connect the other side of the resistance to the terminal on the light switch from which the wire was just removed.

The completed switch is mounted just below the wheel and is readily accessible.

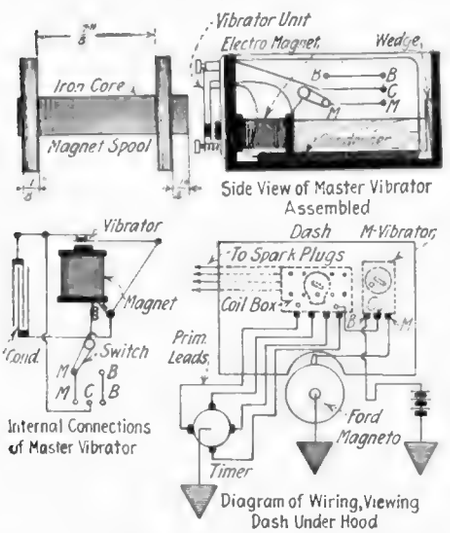
Contributed by RICHARD C. RHODES.

Second Prize $15.00

A MASTER VIBRATOR FOR SPARK COILS

Having often seen master vibrators on Ford cars, and wanting one myself, I proceeded to make one as follows: From an old Ford coil, remove one side, and dig out the condenser, primary and secondary coils. Save the condenser and the wire from the primary.

Next make up a spool with a soft iron core and fibre ends, with the dimensions shown in the accompanying diagram. Wind this spool with six layers of the wire taken



How to Build a Master Vibrator for Ignition Spark Coils on Ford Car.

from the primary coil, bringing both ends of the wire out through the fibre.

On one side of the box from which the coil was removed, mount a three point switch and three binding posts, all of which parts are generally found among the odds and ends around the shop.

The magnet and condenser are now mounted in the box and secured therein with a wooden strip and wedge as shown in the illustration. Connect all the parts as shown herewith and solder all connections. Then fill the box with some kind of insulating compound, such as paraffin or beeswax.

Mount the vibrator on the dash beside the regular coil box, and wire as shown. Now tighten down the adjusting screws on all the vibrators on the regular coils, and adjust the master vibrator.

When properly adjusted, this system will give a hot fat spark, of even intensity, to all four plugs, thereby saving gas and oil and giving the motor greater power.

Contributed by L. I. MACBRIEN.

NOTICE TO CONTRIBUTORS

KINDLY note a change in this contest. For the coming months we would like to receive from our contributors articles on the following subject:

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know of. What we are particularly interested in are novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or suggestion be practical. The term PRACTICAL will be the keynote of this contest.

You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

FIRST	PRIZE.....	$25.00
SECOND	PRIZE.....	15.00
THIRD	PRIZE.....	10.00

All other accepted articles which win no prizes will be paid for at the rate of $1.00. Each article submitted should not be longer than about one hundred to two hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.

LIGHTING A CAMP FIRE FROM A SPARK PLUG

With so many people interested in motor camping the following tip may at some time be found of use to them.

While on a camping trip, I found, one evening when starting to build the cooking fire, that I was entirely out of matches. Not wishing to drive to the next town to procure some, I finally hit upon the following method for lighting the fire. I removed one of the spark plugs from the motor of the auto, and leaving the end of it connected to the ignition wire, laid it on its side on top of the engine. I next saturated a piece of paper with gasoline, placed it between the points of the spark plug, and turned the motor over.

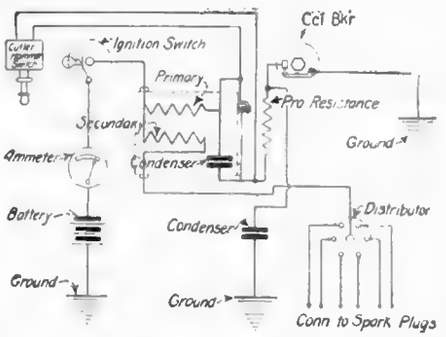
The sparks between the points of the plug ignited the paper at once, and I was able to light the fire with it.

Contributed by K. D. MINARS.

Third Prize $10

USING VIBRATOR TO START ENGINE

The car that I first tried this stunt on was of the six cylinder type, which had been driven about ten thousand miles. Some of the cylinders were worn to such an extent that considerable oil passed by the rings and fouled the spark plugs, which as a rule necessitated taking the plugs out to clean them. This was a considerable nuisance when wishing to start the car in cold weather.

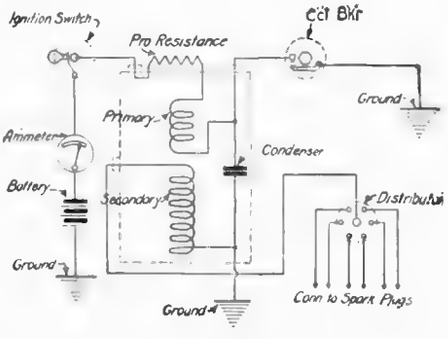


Revised Hook-Up for Auto Ignition, Allowing Either Make-and-Break or Vibrator Spark.

This car was equipped with a Remey make-and-break ignition system, which I changed as follows.

I removed the standard coil and substituted a small K-W coil with vibrator, such as used on Fords. Now this type of coil, when operating with vibrator, produces a much hotter spark than a single impulse coil, but leaving the timer set as it was, this coil would produce a spark as soon as the contacts closed, which was about five degrees before they opened; this had the effect of setting the spark to fire ahead, which I might have compensated for by resetting the timer, but I decided to leave it in this advanced position.

With a single pole C-H switch on the dash, I could change the circuit thus from make-and-break, to vibrator type ignition. When the C-H single pole switch is closed, it short-circuits the spring vibrator, giving make-and-break ignition. With the switch open, jump spark ignition is used.

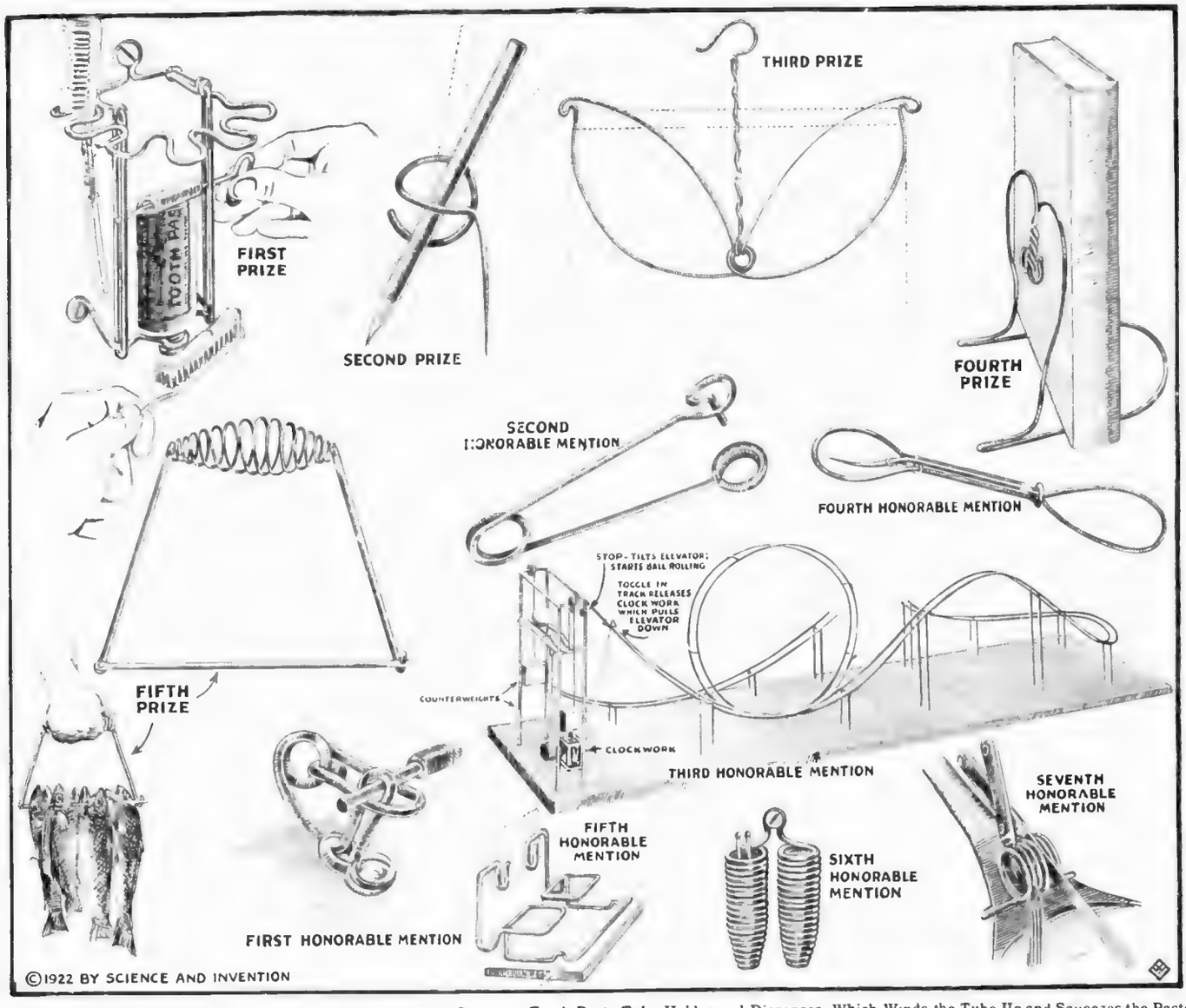


The Old Make-and-Break Ignition System in Use on Mr. Goldfield's Car.

In operating, put switch on dash to make-and-break position and kick in the starter button. While starter is turning motor over, change switch to vibrator position and presto!—it's off.

This has taken all the worry out of starting, and on the road if the motor misses occasionally, I change to vibrator type, and in a block or two the motor will be hitting even enough to allow changing the switch to make-and-break, which position is best to operate continuously.

Contributed by E. R. GOLDFIELD.



The Winning Ideas In Our "Bent Wire Contest"—First Prize Goes to a Tooth Paste Tube Holder and Dispenser, Which Winds the Tube Up and Squeezes the Paste Out, the Rack Also Serving to Support Several Tooth Brushes As Shown; Second Prize Goes to the Inventor of the Simplest Drafting Compass, Made From Bent Wire and a Pencil; Third Prize Goes to the Skirt Hanger Idea; Fourth Prize Is Awarded to the Inventor of a Wire Book Rack; Fifth Prize Goes to the Fish Carrier Made From Four Pieces of Wire. The First "Honorable Mention" Is for a Bent Wire Binding Post; Second Honorable Mention Comprises the Simplest Cherry Pitter; Third Honorable Mention Is An Interesting Toy, While the Fourth Is a Milk Bottle Paper Cap Remover; Fifth Is For a Pen and Ink Stand; Sixth—a Match Holder, and Seventh—Knife and Fork Holder, Adaptable to Any Frying Pan.

"Bent Wire Contest" Winners

HARK there and listen to what the judges of the Bent Wire Contest have decreed. The first prize in this contest, $50.00 in gold, is awarded to D. C. Willis, of 2704 Avenue H, Eusley, Ala., for a tooth-brush holder and tooth paste tube-holder, made entirely of bent wire. The tube-holder is made of a piece of wire split in the center, so that the edge of the tooth paste tube can be gripped therein. It runs between two parallel straight wire guides. The neck of the tube is inserted into a little wire loop, provided for that purpose.

Mr. Ruch, of 1702 E. 19th St., University Pl., Nebraska, submits a bent piece of wire, which acts as a draughtsman's compass. Mr. Ruch secures second prize in our contest. Twenty dollars is the award.

A skirt hanger, designed by E. K. Downer, of New London, Ohio, has been granted third prize, a sum of $15.00 in gold. The skirt can be kept in a very fine condition on this hanger, which presents no sharp or rough edges to tear the finest or flimsiest materials. The device will fit large or small skirts. It is merely necessary to attach the skirt immediately below the hook-like pieces and close the belt.

For a book rack Mr. G. B. Ashton, Angola, Indiana, is awarded fourth prize. There were several book racks entered in this contest, the judges finally deciding upon the device submitted by Mr. Ashton. The $10.00 prize is awarded for this clever design.

Speaking of vacations, L. S. Roome, of Duncan, British Columbia, wins the fifth and last prize for a fish carrier. Mr. Duncan's model seemed to have been used a great deal. The device is made with a spring handle, to which are attached two legs, one of which is bent upward into the form of a hook, and the other is secured by means of a rivet to a cross arm. The fish are lined up on this carrier, and may easily be carried home. The entire device may be folded into a tiny bag, small enough to be carried in the inside coat or vest pocket.

The device forwarded by F. J. Stemmrick, of East Pittsburgh, Pa., a unique binding post, here illustrated, deserves the first honorable mention in the opinion of the judges. This binding post, when constructed out of spring brass, makes a practical device for radio sets.

The second honorable mention goes to Dr. Leonard R. Perkey, in the Morgan Building, for a cherry pitter.

The third honorable mention is for a toy, of unique construction and design, from L. W. Van Wegen, Tombell, Beaver County, Pa. It consists of a track constructed of two parallel wires. A ball starts at the top, and in its journey downward along the track loops the loop and jumps across an open space. At the end of its course it is carried to the top again by an elevator worked by clockwork.

The fourth honorable mention is deserved by the device submitted by R. Nowell, of Crosby, Minn. It is a milk bottle cap remover and replacer. A twisted piece of wire, as shown here, terminates at one end in a sharp point, this point is plunged through the top of the bottle cap, and the same is removed.

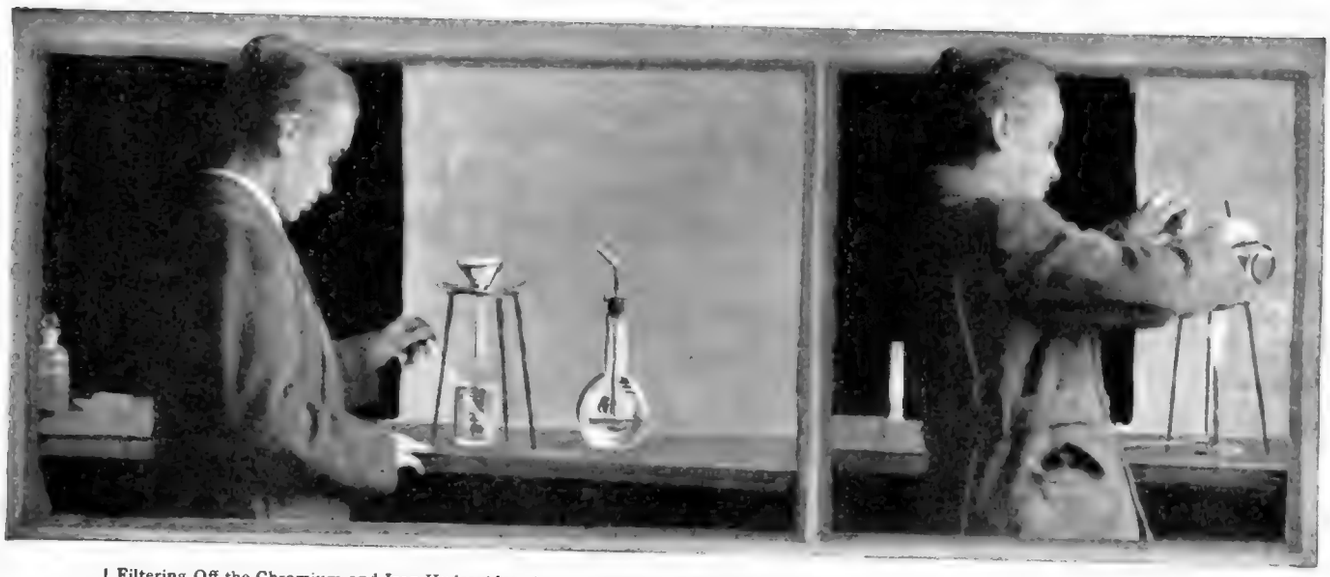
An ink-stand, submitted by Mr. Shryock, of Lexington, Kentucky, made of one piece of stiff wire, and mounted on a block of wood, holds not only the ink bottles, but also paper or envelopes in the back of the stand, a calendar in the clips at the rear, and the pens in front of the ink bottles. His match holder gets sixth honorable mention.

From Mr. Charles J. Belden of the $\frac{7}{4}$ ranch, at Pitchfork, Wyoming, comes a device which is attached to the handle of the skillet to hold forks or spoons.

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

QUALITATIVE ANALYSIS—FOURTH PAPER



Filtering Off the Chromium and Iron Hydroxides.

Dissolving the Precipitate of Aluminum Hydroxides Obtained in Group III in Porcelain Dish by the Addition of Potassium Hydroxide.

IN the previous paper we had just completed the preliminary experiments for the metals of Sub-Group B of the second main group of the metallic elements. We shall now take up their systematic analysis.

Analysis of Sub-Group B.—In an Erlenmeyer flask place about 10 cc. each of solutions of salts of arsenic, antimony and tin. Warm them and precipitate their sulphides with hydrogen sulphide in the usual way. Filter and wash the precipitates. Then with a spatula transfer them to a test tube or small beaker and dissolve with yellow ammonium sulphide, as in the preliminary experiments. Now add dilute hydrochloric acid until an acid reaction is obtained with litmus paper. This reprecipitates the sulphides. Filter and wash them. Of course, when we know that none of the other metals of Group II is present, this solution in yellow ammonium sulphide and the reprecipitation are unnecessary. If other metals are present, however, their separation would not be possible without this procedure.

Now introduce the precipitate of the sulphides of these metals formed last by the addition of the acid into a test tube and boil with 5 or 6 cc. of hydrochloric acid consisting of equal parts of the concentrated acid and water. This will dissolve the sulphides of antimony and tin, but not arsenic sulphide. Now dissolve the latter compound with 1 or 2 cc. of concentrated hydrochloric acid and a bit of potassium chlorate. Next add ammonium hydroxide until the solution is alkaline. If a residue remains filter. Then add some ammonium chloride solution and magnesium sulphate. Shake vigorously and then rub the inside of the test tube or beaker with a hard glass rod. Crystals of magnesium-ammonium arsenate should form. Cooling will also assist in the formation of the crystals.

To test for tin and antimony boil the solution containing these metals until all the hydrogen sulphide has been expelled. Divide it into two portions. To one add a small iron nail and hydrochloric acid. Warm for a few minutes. This will generate nascent hydrogen, which will reduce the antimony chloride to metallic antimony and the stannic chloride to the stannous form. Now add mercuric chloride to the solution and it will be reduced by the stannous chloride, giving a precipitate of mercurous chloride and indicating the presence of tin.

The antimony may be detected, as in the preliminary experiments, by placing the second portion of the above solution in a porcelain dish with a piece of platinum and a bit of zinc, bringing the two metals into contact. The action of the simple electric couple which is thus formed will reduce the antimony chloride to metallic form, leaving a black stain on the platinum. To prove the presence of antimony the stain must be black and not simply gray. The platinum foil may be cleaned as indicated in the preliminary experiments.

Before proceeding with the metals of the next group it would be excellent practice to prepare a solution containing metals of Group I and some from each of the subgroups of Group II. Then systematically separate and identify each metal. Remember that if lead is present it must be looked for both in Group I and in Group II.

Metals of Group III.—These metals are known as the Ammonium Hydroxide Group and include aluminum, chromium and iron. This time we shall not perform any preliminary experiments, but start with a mixture of the metals.

In a small beaker or Erlenmeyer flask place about 10 cc. each of solutions of chrome alum, potassium alum and ferric chloride. Ferrous chloride may be substituted for the ferric salt or may be added with it. To this mixture add a little concentrated nitric acid and several cc. of ammonium chloride solution. Then boil in order to oxidize any ferrous iron that may be present to ferric form. In the regular course of analysis this procedure will be necessary, for the hydrogen sulphide used in precipitating the metals of the previous group, will have reduced the iron to ferrous form, and it must be in ferric form for the work of this group.

Now add to the solution ammonium hydroxide until you just obtain an alkaline reaction. If much excess of ammonium hydroxide is added the mixture must be boiled in order to drive off this excess of ammonia. Then filter and wash the precipitate thoroughly with hot water containing a little ammonium chloride solution. The ammonium chloride must be present in order to prevent the precipitation of the hydroxides of the metals of following groups.

Aluminum.—Transfer the precipitate, which will contain the hydroxides of the three metals of this group, to a porcelain dish and add 2 cc. of potassium hydroxide solution, together with an equal volume of water. (The potassium hydroxide solution should contain 112 g. to the liter.) Boil for one minute and allow the dish to cool. Add a little water, filter and wash the remaining precipitate. The aluminum will have gone into solution, forming potassium aluminate, while the iron and chromium will remain as hydroxides in the precipitate.

Now add dilute hydrochloric to the filtrate until it is just acid to litmus paper. Then add ammonium hydroxide until the solution is alkaline when tested with litmus and warm. A white flocculent precipitate of aluminum hydroxide will appear, although it is sometimes slow in forming.

Chromium.—Transfer about two-thirds of the precipitate left from the previous filtration to a porcelain dish, cover with water and introduce a small quantity of sodium peroxide. Boil for a few moments; then cool and filter. The filtrate will be yellow, indicating the presence of chromium, the chromium hydroxide having been oxidized to sodium chromate. If a little lead nitrate solution is added to it a heavy precipitate of lead chromate (chrome yellow) will be obtained.

Iron.—Dissolve the remaining portion of the precipitate in about 5 cc. of dilute hydrochloric acid. The solution should be clear. Upon a watch glass place a drop of a solution of potassium sulphocyanate, and with a clean glass rod transfer a drop of the filtrate containing iron to this reagent. If iron is present a blood red color will appear. This is a very delicate test, even small traces of iron being sufficient to give it.

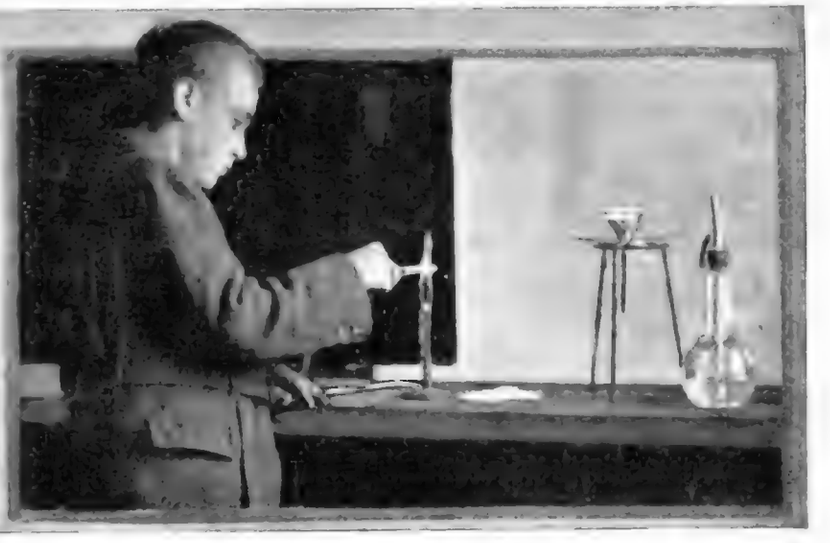
Therefore, in order to be certain of the presence of iron in the substance you are analyzing, a blank test should be with the reagents used, to discover whether they might not have been contaminated with iron. Better still, test a very small portion of the original sample by boiling with a few drops of nitric acid, cooling well, and adding potassium sulphocyanate. If this gives the test there can be no doubt of the presence of iron.

chemist always looks for indications. When subsequent groups must be looked for, this filtrate will, of course, contain the metals of these groups. Therefore, in any case add dilute hydrochloric acid to acid reaction, filter without heating, and in general analysis set away the filtrate.

To determine whether this fine precipitate on your filter is a nickel compound test it with the borax bead. Make a small loop on the end of your platinum wire, heat it

other drop of nitroso-beta-naphthol and repeat the process so as to insure the complete removal of the cobalt. The red precipitate is a cobalt compound. The filtrate will contain the nickel. To it add 5 cc. of sulphuric acid and 1 cc. of nitric acid and evaporate under a hood until the white fumes of sulphur trioxide appear and the solution becomes dark in color. Add 1 cc. of nitric acid and evaporate again. Repeat this operation until, when the solution is evaporated to a

Oxidizing Ferrous Iron to Ferric Form in Group III.



Making the Borax Bead Test for Cobalt.

Metals of Group IV—In this group are included cobalt, nickel, manganese and zinc. The name *Ammonium Sulphide group* depends upon the fact that the sulphides of these metals are precipitated in alkaline solution by ammonium sulphide.

Since ammonium sulphide is the group reagent it will first be necessary to prepare a quantity of it. This is done in exactly the same way that yellow ammonium sulphide was prepared, except that no sulphur is added at the end.

To learn the process of separation prepare a mixture of solutions of salts of these metals. Any soluble salts—chloride, nitrate or sulphate—will give satisfactory results. To this mixture add ammonium chloride solution and then make it slightly alkaline with ammonium hydroxide. Now add the group reagent, ammonium sulphide. Filter and wash with hot water containing a little ammonium sulphide. The ammonium sulphide in the wash water prevents the sulphides from redissolving. Test the filtrate with a drop of ammonium sulphide in order to determine whether precipitation has been complete. If not, more of the group reagent must be added, followed by filtration and washing. This testing for complete precipitation is a most important step in all cases, where succeeding groups must be taken into account.

Another point of importance is the fact that the filtrate obtained in the above process may be dark in color. This always indicates the presence of nickel, and a skillful

in the flame of the Bunsen burner and then dip it into borax powder. Heat in the oxidizing flame of the burner until the borax fuses into a clear, glassy bead. Then touch the bead to the precipitate or, if there is not much of it, wrap some of the filter paper about the bead and heat in the oxidizing flame. If nickel is present the bead will be violet when hot and brown when cold.

Cobalt and Nickel.—The precipitate obtained with ammonium sulphide will contain the sulphides of all four of the metals of this group. Place it in a test tube or small beaker and add a little of a quite dilute solution of hydrochloric acid, shaking thoroughly. This will dissolve the manganese and zinc sulphides but not those of cobalt and nickel. Save the filtrate.

Now to determine the presence of cobalt make a borax bead test. A deep blue will be obtained. Unless the presence of nickel has already been conclusively proved, the following procedure must be carried out: Put the precipitate of cobalt and nickel, paper and all, into a porcelain dish and boil with 5 cc. of aqua regia (concentrated hydrochloric and nitric acids, three to one). Filter and evaporate the filtrate very carefully until it is just dry. Add two drops of hydrochloric acid and 2 cc. of water and warm until the salts dissolve. Place the solution in a test tube and add 5 cc. of a solution of nitroso-beta-naphthol. Heat the test tube and allow it to stand for five minutes. A red precipitate is obtained, which must be filtered off. To the filtrate add an-

few drops, it remains a clear yellow. Cool the solution thoroughly and add very carefully 5 cc. of water. Transfer it to a small flask or beaker, neutralize with strong ammonium hydroxide until a slight alkaline reaction is obtained. Then pass into it hydrogen sulphide. A black precipitate of nickel sulphide will result. To confirm the presence of nickel make the borax bead test, as already described.

Manganese.—To the filtrate obtained in the previous process add a drop of dilute hydrochloric acid and boil to expel the hydrogen sulphide. When cold add potassium hydroxide solution until a distinct alkaline reaction is obtained with litmus paper. The precipitate which forms is manganese hydroxide. Filter it off and save the filtrate, for it will contain the zinc. Now prepare a sodium carbonate bead with the platinum wire in the same way that the borax bead was made. Touch it to the precipitate and heat in the oxidizing flame. A green bead proves the presence of manganese.

Zinc.—Into the filtrate obtained from the manganese hydroxide precipitate pass hydrogen sulphide. A white precipitate of zinc sulphide shows the presence of zinc. To prove it conclusively make the cobalt nitrate test for zinc. Filter the precipitate and place some of it in a cavity hollowed out of a stick of charcoal. Heat this strongly with the flame of a blowpipe, add a drop of a solution of cobalt nitrate, and reheat with the blowpipe. If zinc is present, a green color will be obtained.

Sex Predetermination

That the sex of babies may be predetermined by injection of chemicals into the mother's body is the theory now being worked on by Prof. Julian Huxley, noted English scientist.

He also believes that twins may be artificially created. He bases this on experiments already conducted with the eggs of the newt.

With regard to sex predetermination Professor Huxley stated the chemical factors in father and mother themselves have sex determining spermatozoa. These are definite substances, the stronger of which—male or female—determines the sex of the child.

These two substances, the female tending to suppress the male and the male the female, in their turn are produced apparently directly by the sex factors in the hereditary constitution of the father and mother.

Mrs. Maud S. Hunter, an English woman farmer, claims to have discovered the secret of sex determination in cattle.

Seven years ago Mrs. Hunter began the business of breeding pedigreed Jersey cattle.

"Subject to one limitation, I can now regulate the sex of the calves born to my cows.

"The limitation is this: It is impossible to settle the sex of the first calf.

"The secret is that the regulation of sex is definitely related to the period chosen for mating. A cow mated at the first possible time after bearing a calf will have another calf of the same sex as the last one. If the opposite sex is desired there must be a certain delay."

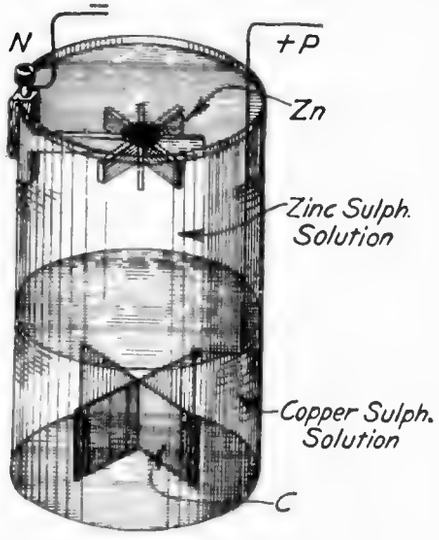
Experimental Electro-Chemistry

By RAYMOND B. WAILES

PART IV—PRODUCTION OF AN ELECTRIC CURRENT BY CHEMICAL REACTION

ONE of the most important branches of electro-chemistry is the subject of electromotive chemistry, or the production of electrical currents by means of chemical reactions and forces.

Batteries, both wet and dry, are common. Chemical changes which produce the electric current emanating from them are still more frequent in occurrence. The transference and migrations of ions, something which has never been visualized, is the cause of the chemical changes, and is therefore the source of the electrical currents. Just how these small invisible particles, ions, produce the electric current will be disclosed here.



The Daniell Gravity Cell. Zinc Metal (Atoms) Displaces Copper Ions (Copper Solution) and Produces an Electric Current.

Our figure 1 shows a simple wet cell, gravity cell, outgrowth of the old-time Daniell cell. Here, a zinc element, shaped in the form of a crow's foot, is surrounded by a solution of zinc sulphate contained in the battery jar. The copper element resting on the bottom is surrounded by a strong solution of copper sulphate. The two solutions do not mix, for the gravity of the copper sulphate is greater than that of the zinc sulphate. On connecting the wires N and P a current of electricity will be produced and flow through the wire.

The action of the cell can be explained as follows: Every atom of each element, such as zinc in the cell, resembles a miniature solar system having a center nucleus and several, sometimes many, bodies whirling about the nucleus. The nucleus is positively charged with electricity: the bodies whirling about the nucleus, called electrons, are negatively charged. The sum of the charges contained on all the electrons equals the charge held by the positive or nucleus body. The zinc atoms of the zinc crow's foot have a tendency to give up two of the electrons surrounding the positive nucleus, and to pass into the zinc sulphate solution as zinc ions. It will be remembered that zinc ions have positive electrical charges. It could be said that the negatively charged electrons set free in this act accumulate on the zinc crow's foot and remain there awaiting to be removed. About the copper plate on the bottom of the cell is a solution of copper sulphate. This solution contains copper ions which are, as most metals are, charged positively. These copper ions tend to leave the copper sulphate solution and deposit themselves as copper atoms—metallic copper—upon the copper plate. In so doing, they rob the copper plate of two negatively charged bodies, the copper electrons, for copper atoms have a miniature planetary system consisting of a positively charged nucleus and a mass of negatively charged electrons surrounding it. The copper ions seemingly attract two negatively charged bodies, the electrons, with the result that the positive charges upon the copper ions are neutralized and copper atoms are formed, which deposit on the copper plate. Since the copper atoms of the copper plate have had two of their negatively charged bodies abstracted from them by the negatively charged copper ions from the solution, the copper plate becomes positively charged, since the charges of the nucleus and the electrons exactly balance or neutralize each other. If now the zinc plate and the copper plate are both connected by means of a wire, the excess electrons on the zinc plate will flow through the wire to make up the deficiency upon the copper plate. The current will flow as long as the wires are connected, and upon breaking the connection between the wires, the current will cease.

The following reaction has gone to completion in the above case:

$Zn+CuSO_4=Cu+ZnSO_4+50.100$ calories.

Here, metallic zinc (Zn) has gone into solution forming zinc sulphate, $ZnSO_4$, while copper has been driven from the solution and converted into copper atoms, Cu. The zinc can be said to have *displaced* copper from its solution, and in so doing, has produced 50,100 calories of heat, which is transformed into electrical energy.

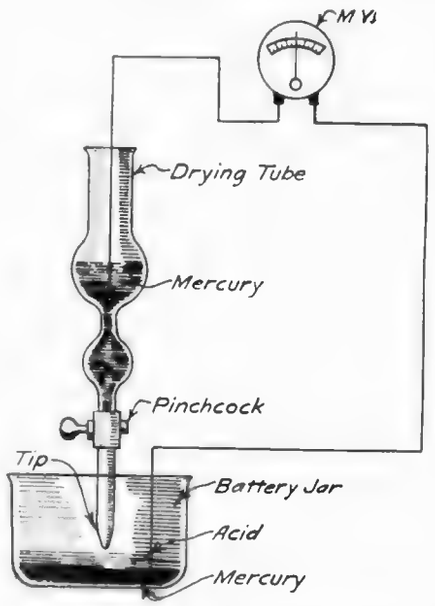
It is possible to arrange the metals in an order which enables one at a glance to determine if they would make suitable elements for a cell, how they behave when placed in a solution, and many other properties. Such an order is called an electromotive series:

Magnesium	+1.5	Lead	—0.15
Aluminum	+1.0	Hydrogen	—0.28
Manganese	+0.8	Copper	—0.6
Zinc	+0.5	Bismuth	—0.7
Cadmium	+0.15	Mercury	—1.02
Iron	+0.14	Silver	—1.08
Cobalt	—0.05	Platinum	—1.2
Nickel	—0.05	Gold	—1.4
Tin	—0.13		

The solution used as the electrolyte of a cell is charged so to speak in accordance to the charge on the metal composing it as found in the above list. The solutions formed of the metals, down to cobalt, are positively charged, or in other words, there is a greater tendency for the metal to pass into solution as ions as shown in the above case with zinc, than there is for the metal to deposit from the solution and form atoms, as in the case of copper in the Daniell cell.

Metals in the above series, when placed in a suitable electrolyte, produce an electric current when connected by a wire. The farther apart in the series the two metals used are set down, the higher the voltage produced will be.

Zinc and copper were used in the Daniell cell. The voltage produced by the cell would be the difference between the voltages produced from each and is shown in the table. The voltage for the Daniell cell would be $+0.5-(-0.60)=1.1$ volts. In this manner, the voltage of any two metals in a suitable electrolyte can be found. The computed voltage is not always the voltage which is indicated by a voltmeter, for—first, heat is produced, and this heat energy is transformed into electrical energy, with some loss in all instances. For instance, the 50,100 calories of heat liberated in the Daniell cell is not all transformed into electrical energy. The results obtained by computation from the series are sufficiently accurate for the experimenter, though.



Two Dissimilar Metals Are Not Necessary for the Production of an Electric Current. Here, Mercury Serves as Both Positive and Negative Elements.

One metal alone can produce a current as shown with the apparatus in figure 2. Here, a calcium chloride or other tube is connected with a pinchcock and mercury is placed in the tube as shown. The beaker contains dilute sulphuric acid and mercury. Both bodies of mercury are connected by means of a wire to a millivoltmeter as shown. On opening the pinchcock and allowing mercury to fall in a fine stream through the glass tip of capillary size and into the mercury in the beaker, a current is produced. This is due to the fact that mercury tends to dissolve in the acid solution, and will then be deposited on the mercury in the bottom of the beaker, producing atoms from ions with a consequent production of an electric current.

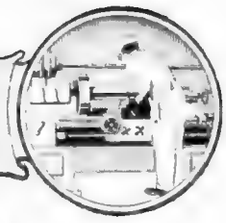
The gravity cell above is called a *displacement* cell, for zinc displaces copper from its solution. *Combination, concentration and short circuited concentration* cells are known. They will be discussed in the next installment

Weighing a Pencil Mark

Scales have long been made which will weigh the difference between two hairs cut to the same length from the same person's head. They are triumphs of mechanism, and are enclosed in glass cases, as the slightest breath of air would impair their records.

The glass cases have a sliding door, and as soon as the weight is placed in the balance, the door slides down. The balances are cleared again, and made ready for further use by the pressing of a button which slightly raises the beams. Two pieces of paper of equal weight can be placed in the scales and an autograph written in pencil on either will cause the other balance to ascend while the needle, which indicates the weight to less than a millionth part of a pound, will move from its perpendicular. One signature containing nine letters was found to weigh two milligrams, or the fifteen thousand five hundredth part of a Troy ounce.

THE CONSTRUCTOR



A Home-Made Carousel

IN many country homes children are permitted to romp around in the yards with practically no form of amusement—real amusement—coming their way for long periods. Trips to the seaside resorts are few and far between. The father interested in his and his neighbors' children can, for the cost of a couple of dollars, build a merry-go-round, entirely safe, which will give many pleasurable hours of fun.

Inasmuch as all dimensions are given in the diagram herewith, there is no necessity in duplicating figures here. We will just mention a few words in regard to the construction of the device. A post having been driven or buried into the ground, so that it is very rigid, is fitted with an old wagon wheel free to rotate about the axle of the wheel driven into a hole bored in the top of the post; or instead of using the axle, a heavy iron bolt is employed. The top of the post has had a large iron washer secured thereto, to act as a bearing for the end of the wagon wheel. Heavy planks of a length not smaller than those shown in the diagram are now bolted to the wood of the wagon wheel and secured to the spokes by passing a bolt through the wooden plank on either side of the spokes, which bolts tighten a face plate similar to a pipe clamp around the spoke, thereby rigidly securing the planks.

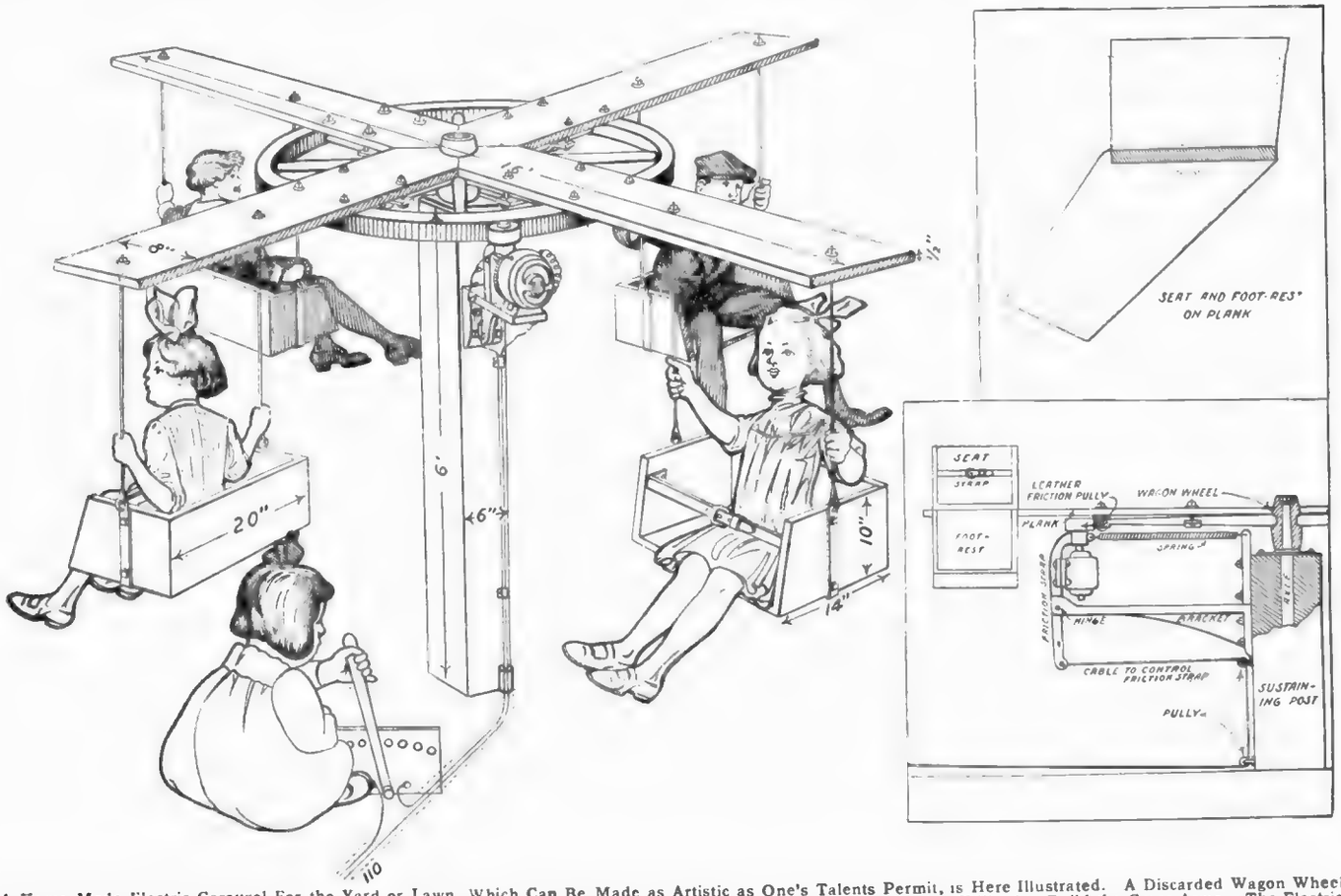
A frame of half-inch strap iron is made to which a one-quarter horse-power motor is attached. This motor is preferably fitted with a leather wheel so arranged that friction of the leather is exerted against the rim of the wagon wheel on the post

The wires to the motor are then led downward along the post itself through a water pipe buried in the ground, and thence connected in series with a rheostat which should be well insulated and protected, inasmuch as children are going to operate it, and it is not a good policy to leave any bare wires or any contact points free with which children could come in contact. The seats of the carousel are suspended from ½-inch iron rods and may be provided with straps for holding the occupants.

Another method of building the motor drive is to mount the motor on a pivoted frame, which frame can be moved into or out of relation with the wagon wheel, carrying with it the motor in frictional contact with the rim of this wheel. The motor is then started by an ordinary snap switch by the attendant, who pulls on the cord arranged as illustrated to free the motor from the wagon wheel.

In this manner, when the children are all seated and strapped in the seats, the releasing of the cord permits the motor to be carried into frictional contact with the wheel, causing the latter to revolve. It will be seen from the diagrams here given that the main idea in the design of this carousel has been simplicity and cheapness. A discarded wagon wheel will cost practically nothing and many owners of houses have a fractional horsepower motor lying around which is not in use. If not, one can be purchased from a motor repair shop at small expense.

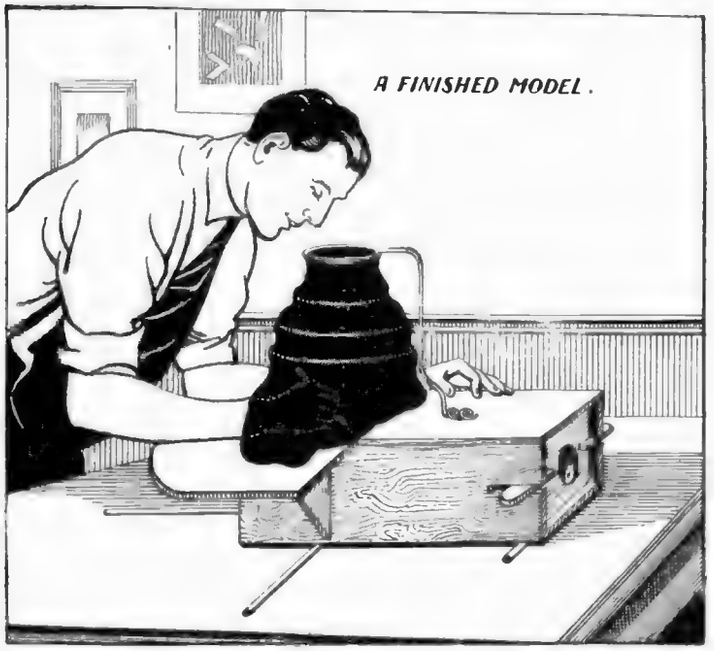
Frictional drive is used, in that very accurate workmanship is not absolutely necessary, as is the case in gear drives. Friction in a device of this nature is likewise far more efficient than the belt drive. The novice will find many other interesting additions or changes which should be made in constructing a device similar to the above. For instance, the entire apparatus could be mounted rather high upon an eight or ten-foot post or a sawed-off tree, in which event the carousel would become an amusement device similar to the flying boats found at the beaches. Instead of using the iron strap to hold the seats in place, ropes could be employed, or the method of suspension of the seats changed in order to permit of the tendency of those seats to swing gradually outward when the device is in motion.

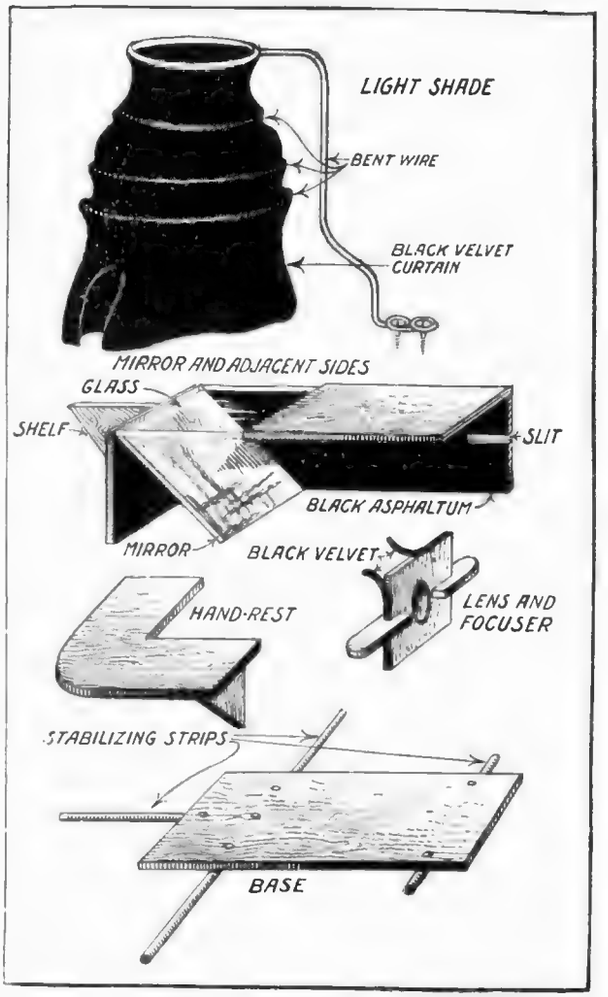


A Home-Made Electric Carousel For the Yard or Lawn, Which Can Be Made as Artistic as One's Talents Permit, is Here Illustrated. A Discarded Wagon Wheel May Be Employed as Shown to Form the Basis of the Carousel Structure, and Either Boards or 2x4-Inch Timber Utilized to Build the Cross Arms. The Electric Motor of About One-Eighth H. P. Capacity Drives the Wagon Wheel by Means of a Leather or Fibre Friction Pulley Connected Thru Mitre Gears to the Motor Shaft, as Shown. The Motor is Stopped and Started by Means of the Switch Which the Child is Operating. An Optional Method of Starting and Stopping This Miniature Carousel is Shown in the Right Hand Corner of the Picture, Where the Electric Motor is Mounted on a Pivoted Bracket, This Bracket Being Moved Toward or Away From Contact With the Wagon Wheel, as Becomes Evident.

Making a Camera Obscura

By CYRIL O'CONNOR





A Camera Obscura is Useful in Many Ways and is a Great Aid in Drawing Perspectives, Making Reductions and Enlargements and for Sketching in General. Its Operation is Based on the Projection of a Scene or Object Thru a Lens on to a Mirror, and Thence Upward on to a Glass Plate Over Which a Piece of Tracing Paper is Placed. The Accompanying Drawings Show How to Build a Good Camera Obscura in Simple Fashion, From a Few Odd Pieces of Wood, a Little Black Cloth or Preferably Velvet, Some Wire and an Inexpensive Lens.

Everywhere about us are objects and scenes so dear that we often attempt to make a permanent record of them by photographing them, or, with our rather poor ability, sketch the places. Unfortunately, few of us are gifted with sufficient artistic talent so necessary for the successful reproduction of the scenes about us, yet many of us prefer the penciled or painted sketches to flat photographic images.

However, with the aid of the Camera Obscura, made as here illustrated, the recording of scenes does not become a very difficult matter, not nearly as difficult as might at first be expected, and the author of this article can safely say that pictures of friends and landscapes can be sketched by a novice. Essentially the apparatus consists of a rectangular box with a lens with focus equal to the length of the box. At the opposite end a mirror is inclined at an angle of 45 degrees. This mirror throws the image of any object to which the lens may be directed on a piece of glass covered with paper, which paper is held in place by pins. The upright image formed on the paper can be easily traced by making a hood of black velvet braced by wires as shown in the illustration, and securing it to the top of the box. This hood is preferably provided with a slit through which the hand of the amateur passes. By looking into the hood and moving the lens holder back and forth a focus will be obtained, at which point the objects will stand out very clearly. It is then a simple matter to trace the image as seen in the box. By following the sketch here shown, the construction of the device is rendered very simple. It is advisable when building this instrument that good lenses be used preferably from a camera, which can be obtained at a very reasonable figure, inasmuch as any style of lense holder may be used. Some very fine lenses appeared on the old style rapid rectilinear cameras which used the cap instead of a between-the-lens shutter. These could be obtained at a very low figure from camera exchange houses. A lens from a four by five camera should not be used in a box in which an image larger than five by seven will appear.

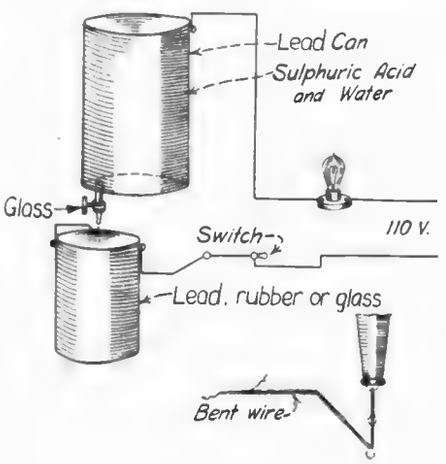
The sliding lens holder is made snug by gluing a thin strip of felt around the edge of the slide.

A Cheap Flasher

The following is a description of an Electric Light Flasher, which I submit.

The materials for this simple device can be picked up around any workshop and the whole assembled very easily. Two cans are needed. One of them is situated on a support above the other. In the former a solution of salt or sulphuric acid is placed. A small pipe and pet cock are fitted to the bottom of this can. To the second can a bent wire is secured by a bolt and its tip allowed to project under the mouth of the pet cock. The distance between tip and mouth should be from 1/16 inch to 1/8 inch. A connecting post is fastened on each can and the device placed in series with a switch and lamp bulb, of course also in series with the supply lines. To operate, turn the pet cock slightly so that drops form slowly and adjust tip of the wire.

Now as the drops form they establish a circuit between the two tanks and hence cause the light to flash on. Due to the extremely slight resistance of the acid solution the lamp will burn practically at full brilliancy. As the drop gets heavier it passes down along the wire and falls into the can, breaking the circuit as illustrated. If sulphuric acid is used as the electrolyte it is necessary to make all parts of lead, glass or hard rubber, establishing connections with lead wires or soft solder.



A Simple and Cheap Flasher for Winking on and off Electric Lights or Other Electrical Apparatus, the Circuit Being Interrupted by the Action of Sulphuric Acid Solution Dripping Thru an Adjustable Glass Stop-Cock from One Vessel into Another.

I have built this device and it worked for six hours without attention.

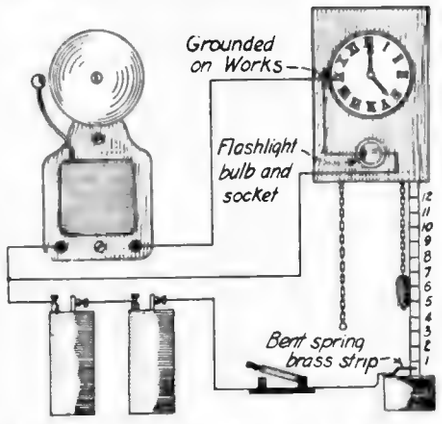
The beauty of it is that a store window having a flashing sign need not operate all night as the lamp automatically goes out when the liquid is exhausted.

Contributed by CONSTANTINE TROY.

Cuckoo Alarm Clock

Cuckoo clocks are seldom if ever equipped with ringing mechanisms, particularly time-alarm devices. I built a clock which may be used as an alarm clock, without any difficulty whatever, and which is remarkably accurate, considering its crudeness.

The cuckoo clock was suspended from the wall in such a manner that as the weight descended, it would touch the floor when its downward journey was completed. Immediately under the weight I then fastened a piece of spring brass and bent it upwardly, so as to form an L lying on its side, and then upon the wall itself I carefully calibrated the hours and half hours, using the point of the acorn weight as the index. One wire led from the brass strip on the floor to two dry cells, then up to the bell, and another wire in parallel with this as shown in the illustration, was connected to a tiny electric light mounted on the face of the clock, either above the face or below it, as desired by the builder. The other wire led from the light and from the bell, was then grounded on the clock works.



If it is desired to have the alarm wake you in three or four hours, the weight is pulled up to the four-hour mark on the scale, and in four hours, almost exactly to the minute, the weight will close the circuit, ringing the alarm and turning on the light until either the weight is lifted again or the switch opened. Similarly if the switch is closed, and the clock wound up, it will ring the alarm whenever the clock runs down. Of course the folks may object to defacing the walls by marking the numbers upon the freshly painted or papered room, in which event a tape measure of the kind that winds up automatically could be used.

Contributed by ARMOND FENTON.

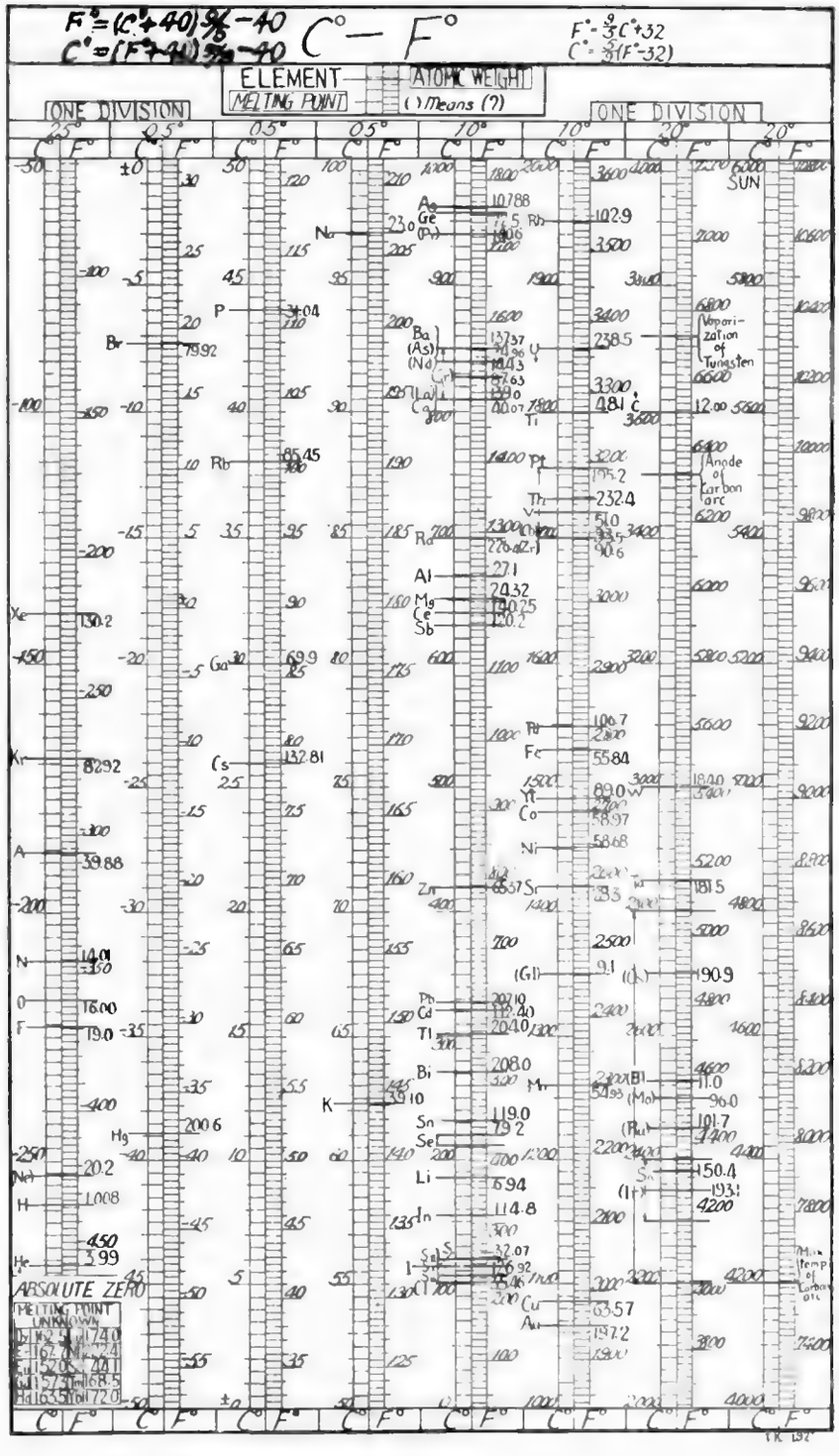
Centigrade and Fahrenheit Conversion Tables

This chart comprises simply two scales (Centigrade and Fahrenheit) side by side. There are eight columns, each column having two scales; the left for Centigrade and the right for Fahrenheit. The temperature increases as one proceeds upwardly in the columns as in ordinary thermometers. The columns are continued from left to right. The chart covers the range from absolute zero to the temperature of the sun. The scale is different in different columns, in order that accurate readings may be obtained at the more important points. The values of individual divisions are: In column 1, 2.5°; in columns 2, 3 and 4, 5°; in columns 5 and 6, 10°, and in columns 7 and 8, 20°.

If one wishes to change from a Fahrenheit reading to Centigrade he locates the temperature on the right side (F°) of the column and simply reads the corresponding temperature at the left of this (C°) or vice versa for changes in the opposite direction. The best result may be secured with the aid of a celluloid or glass having a scratch mark upon it in the form of a right-angled cross.

Chemical elements are arranged at their corresponding melting points. Arrows indicate melting point variations of higher or lower order. Brackets show indeterminate melting points between the closure of the brackets. The numbers written in standing type express the atomic weight of the elements. Contributed by

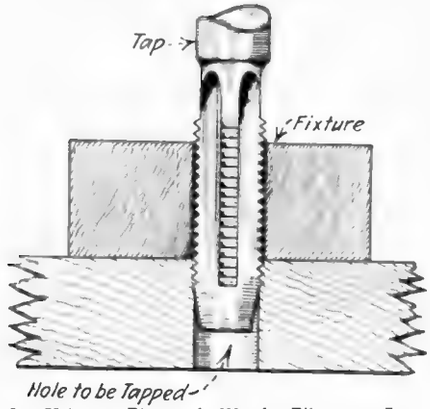
TOSHIO KAWAMURA.



GUIDING THE TAP WRENCH

It is very difficult to tap a hole properly unless something is used to guide the tap. A small block of wood with a hole in it will serve this purpose very well, as shown in the diagram here given. An assortment of small blocks with different sized holes for various taps should be included in the mechanic's outfit to act as such guides.

Contributed by F. H. SWEET.



By Using a Piece of Wood, Fibre or Iron, Drilled with a Hole to Pass a Tap, This Will Act as a Guide and Prevent Breaking the Tap.

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

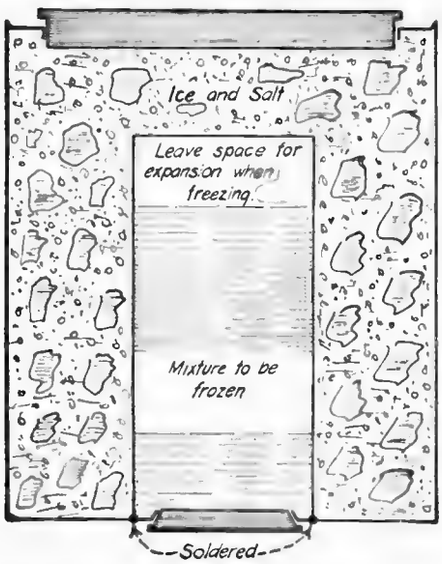
FIRST PRIZE, $15.00

A SIMPLE HOME-MADE FREEZER

A very simple and efficient ice-cream freezer may be quickly constructed at practically no expense.

The container for the custard or fruit juices consists of a one- or two-quart can such as various cooking compounds or infant foods are packed in, and should have a tight-fitting cover of the type that pries off. This can is soldered upside down into the bottom of a larger can of similar construction, and can be obtained from your grocer or confectioner, who receives candy and salted peanuts in them. This completes the freezer, and the operation is simply to place the custard in the smaller can, and crushed ice or snow mixed with about one-fourth its volume of salt, in the other. The freezer is then set away for about an hour. Occasional shaking accelerates freezing, and if filled before starting on an auto picnic, and strapped to the running board of an auto, it will be ready for use when dessert is desired. There should be three inches of space between the wall of the smaller and that of the larger can.

Contributed by HARRY H. HOUCK.



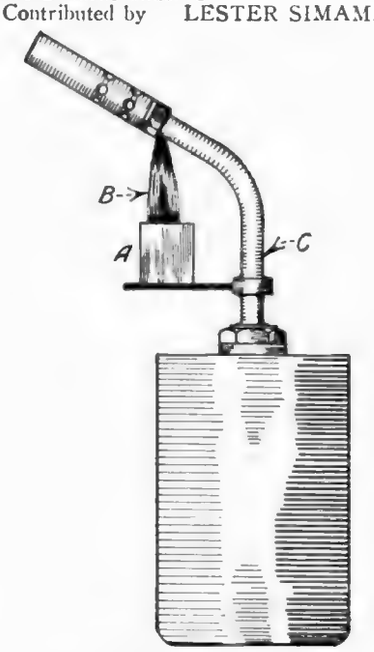
Here is the Ice Cream Freezer You Have Been Looking for—it Requires no Cranking and All One Has to Do is to Place the Ingredients in a Container as Shown; then Pack the Larger Container with Ice and Salt, and Allow it to Stand for About an Hour

SECOND PRIZE, $10.00

SELF-GENERATING DEVICE ON BLOW TORCH

Usually a small blow torch as shown in sketch is started by holding the flame of two or more burning matches anywhere under the gooseneck C. This is very inconvenient, particularly at times when a slight draft of air blows out the matches or cools the gooseneck almost as quickly as it is heated. Accordingly a different method may be employed. An empty 32 calibre rimless cartridge, A, is wired to the gooseneck C as shown. A few drops of alcohol or gasoline are put into the generator and lighted so that the flame B burns under C.

Contributed by LESTER SIMAM.



A Self-Generating Device for Blow Torches, Comprising a Cartridge Shell Secured to the Neck of the Torch by a Piece of Wire or Otherwise. The Flame B Heats the Vaporizer Tube and Causes the Torch to Start Up in Jig Time

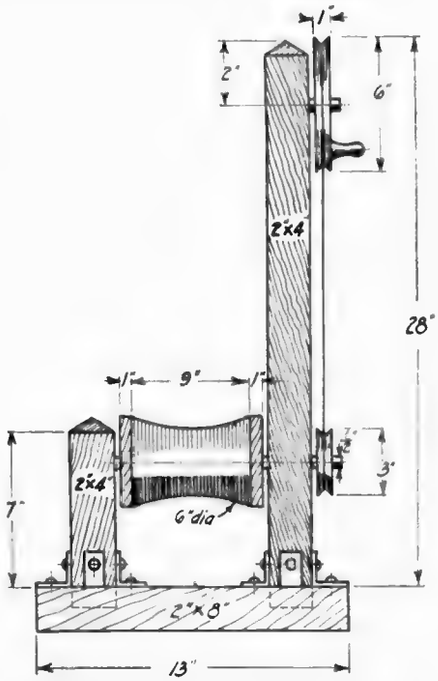
THIRD PRIZE, $5.00

HOME SHOE POLISHER

Some time ago I constructed a shoe polisher, shown in the illustration herewith, which has given me very satisfactory service for more than a year. The method of construction was, indeed, simple. I first procured a base at least 2 inches thick, 13 inches long, and 8 inches wide, and in addition to that, a 2" x 4", at least a yard long. Planing the 2" x 4" smooth I cut off a piece 28 inches long, and then used the remaining piece for the short upright of the stand—this should be 7 inches long. Half way thru this 7-inch piece I drilled a hole for the reception of a shaft 1 inch from the top. The 28-inch piece was likewise drilled, but clear thru instead, one hole being situated 6 inches from the bottom, and the other 2 inches from the top. From several pieces of soft pine I cut some round discs. These pieces were 1 inch thick. Three were turned to a diameter of 6 inches, and the fourth to a diameter of 3 inches. One of the 6-inch discs was then grooved, as was the 3-inch disc. A half-inch shaft threaded, or otherwise prepared for the fastening of the pulley wheels was then procured, and eight small brackets purchased. The base was then chiselled out for the reception of the 2" x 4"'s, and the entire device was ready for mounting, with, of course, the exception of the polisher proper.

There are two ways to make this polisher. The first is to cut a number of pieces of Canton flannel in the form of circles. These are all grouped together and then bolted to two of the 6-inch wooden wheels. The method I used, however, was to tack a piece of cloth to the edges of the two wheels; this cloth should be 10 inches long. A suitable binder, such as a leather strip or canvas strip, is placed immediately under the tacks to prevent the cloth from tearing. The entire device is then assembled, as shown in the illustration, leaving sufficient lag between the two 6-inch wheels, holding the cloth, to give it a concave appearance. A handle is fitted to the 6-inch pulley near the top of the 28-inch upright, which, of course, should be the grooved pulley, and this is connected with the 3-inch wheel by means of a belt. All the shafts are then oiled and polishing paste is put upon the cloth; then by moving the foot around, while the handle is being turned, a rapid, perfect polish is applied to the shoes. The device is just as speedy in operation as an ordinary cloth, and yet it possesses the advantage of preserving clean hands, and giving the shoes a polish, instead of merely brushing them.

Contributed by CLYDE ROSSMORE.



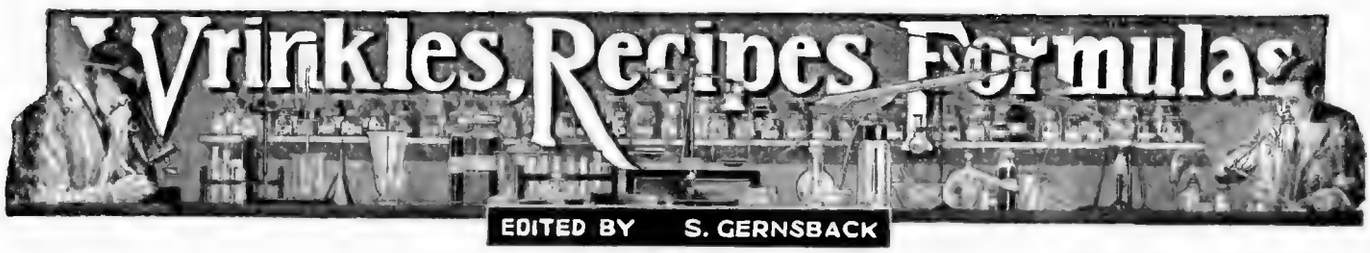
Mr. Rossmore Here Shows Us How to Shine Shoes Easily, by Simply Turning a Crank Placed at a Convenient Height Above the Floor. The Concave Roller at the Bottom is Fitted with a Polishing Cloth, Cotton Flannel Being Very Good for the Purpose

CEMENT FOR AQUARIUM

Many persons have attempted to make an aquarium but have failed on account of the extreme difficulty in making the tank resist the action of water for any length of time. Below is a recipe for making a cement that can be relied upon; it sticks to glass, metal, wood, stone, etc., and hardens under water:

One part by measure, say a gill, of litharge; one gill of plaster of Paris; one gill of dry white sand; one-third of a gill of finely powdered resin. Sift and keep corked tight until required for use, when it is to be made into a putty by mixing in linseed oil with a little patent dryer added. Use while fresh.

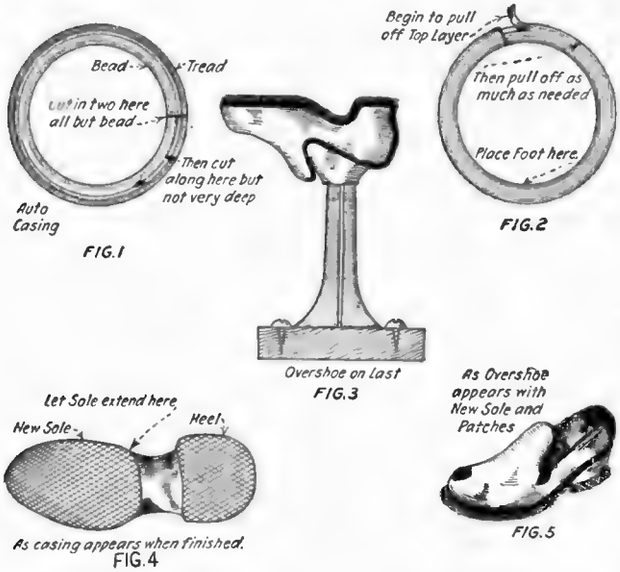
Contributed by F. JOHNSTONE.



THIS MONTH'S $5.00 PRIZE

RENOVATING RUBBERS

Here is a method which I have used for a long time for increasing the life of rubbers or overshoes by providing them with non-skid renewed bottoms. When the soles of the overshoes begin to wear and get thin and the tops leak water, do not throw them away. Just place them aside for some rainy day when you have an hour or so and can haul them out of your locker and set about repairing them.



The Several Stages to be Followed in Renovating Rubbers by Means of Sections of Rubber Cut From an Old Auto Tire or Shoe Are Here Illustrated. These Renovated Rubbers Moreover Are Frequently Better Than When New, as They Will Have Heavy Non-Skid Soles and Heels. The Usual Method of Performing This Operation is by Means of Rubber Cement, But a First Class Job Can be Done Best by Vulcanizing.

The only material needed is an old automobile casing (a 30 by 3½ is best), a can of tire cement, patches, a box of tacks, a shoemaker's last, a hammer and a sharp knife. Of course, when once this material is procured, any number of rubbers can be repaired, but the initial cost is without a doubt quite high.

First the scraper that comes with the can of cement patches is used to scrape the soles of the rubbers clean. Then separate the inside lining of the casing and cut it longitudinally about two inches from the bead along the length of the casing. Placing the foot in the tire as illustrated in figure 2 and grasping the top layer of the casing, you will find that it separates rather easily. After the desired strip has been removed sufficient to cover the rubbers, cut off the end.

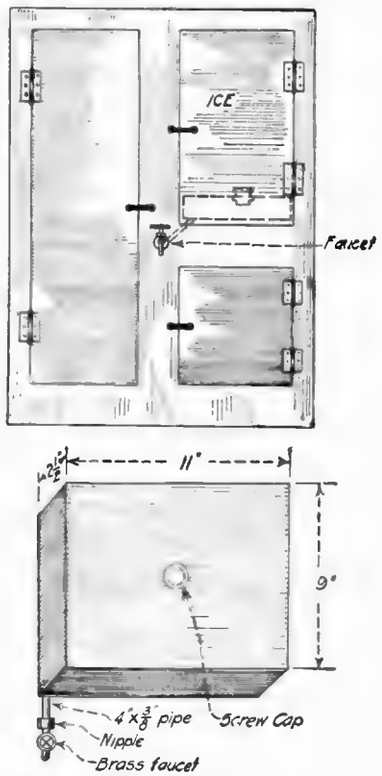
Slicing this portion into pieces so as to cover the heels and the soles of the shoe, place the rubber on the last, which should be large enough to fit rather snugly. A coat of rubber cement is then applied to the rubber and to the tire and allowed to dry. Another coat is then given to the rubber, and the piece of casing is firmly secured on the sole of the overshoe. A few tacks driven in along the edges, especially at the toe and instep, will hold it in place. Placing pressure in the form of several flat irons upon the sole makes a very good job.

Should the casing pull loose along the edges, apply a little more cement. If there are holes along the top, these can be repaired by patching with an ordinary tire patch and sandpapering the patches down smoothly when they are dry. The soles and heels are trimmed with a sharp knife, after the cement has hardened. Be sure to wet the knife; it will cut better.

A WATER-COOLER FOR THE HOME

Cold water, much desired in the summer time, is seldom obtainable, unless bottles of water are placed in the ice chest. These must be repeatedly filled, and are often a decided nuisance. Desiring to obviate this inconvenience I made a water cooler which has for two seasons served the purpose to great satisfaction. The method of construction was as follows:

I first measured the bottom of the ice compartment of my icebox and found the same to be 13" x 11", so I asked a local tinsmith to make a water-tight box of zinc, measuring 11" x 9" x 2½" high, just 2" smaller than the ice compartment so that the box would fit into it with ease. I then had a screw cap inserted in the center of the top for the purpose of filling said box with water. In one corner I had a piece of ⅜" brass (or pure tin) pipe soldered. This pipe, a nipple and a brass faucet were purchased from a steamfitter. After the box was made I drilled a ⅜" hole through the front of my icebox at any suitable position, as shown in the above drawing. I next placed my water box with the piece of pipe extending through the hole I drilled, in the proper position in the icebox, slanting it slightly toward the front corner to insure complete exhaustion of the supply. On the end of the pipe extending through to the outside of the box I screwed the nipple and brass faucet.



A Simple Scheme for Keeping Ice Cold Drinking Water Always on Tap. This Idea Involves the Construction of a Tin or Galvanized Sheet Iron Container of the Approximate Dimensions Shown. This Metal Water Tank is Placed in the Bottom of the Ice Chamber of the Refrigerator. It Is Filled With Water When Necessary Through the Screw Cap on Top, and It Should be Flushed Out Thoroughly at Least Once a Day to Keep It Sanitary.

I fill the box with water every time I get ice.

Contributed by IRVING KAHN.

$350.00 in Prizes in This Issue

Today SCIENCE AND INVENTION offers more various prizes than any periodical, and these are all prizes that are within the reach of everyone. These are prizes where almost every reader can participate. This month there are $350.00 in prizes, which will be found under the following headings:

Perpetual Motion Contest—$150.00—See page 338.

Motor Hints Contest—$50.—See page 346.

How-To-Make-It Department—Three prizes, totalling $30.00, besides usual rate paid for articles not winning prizes—See page 354.

Wrinkles, Recipes, and Formulas Department—$5.00 monthly prize, besides amounts paid for other articles published in this department—See page 355.

Radio Department—See page 359, "How to Make a Loud Talker"—$100.00 in prizes.

In addition to this, note that SCIENCE AND INVENTION pays the highest rates for contributions of all sorts. Ordinary contributions are paid for at the rate of one cent per word, and we have paid as high as three cents per word for special experiments, or special articles containing novel and scientific information.

The Editor is always glad to receive such contributions for consideration.

RADIO DEPARTMENT

Marconi Explains Directional Radio

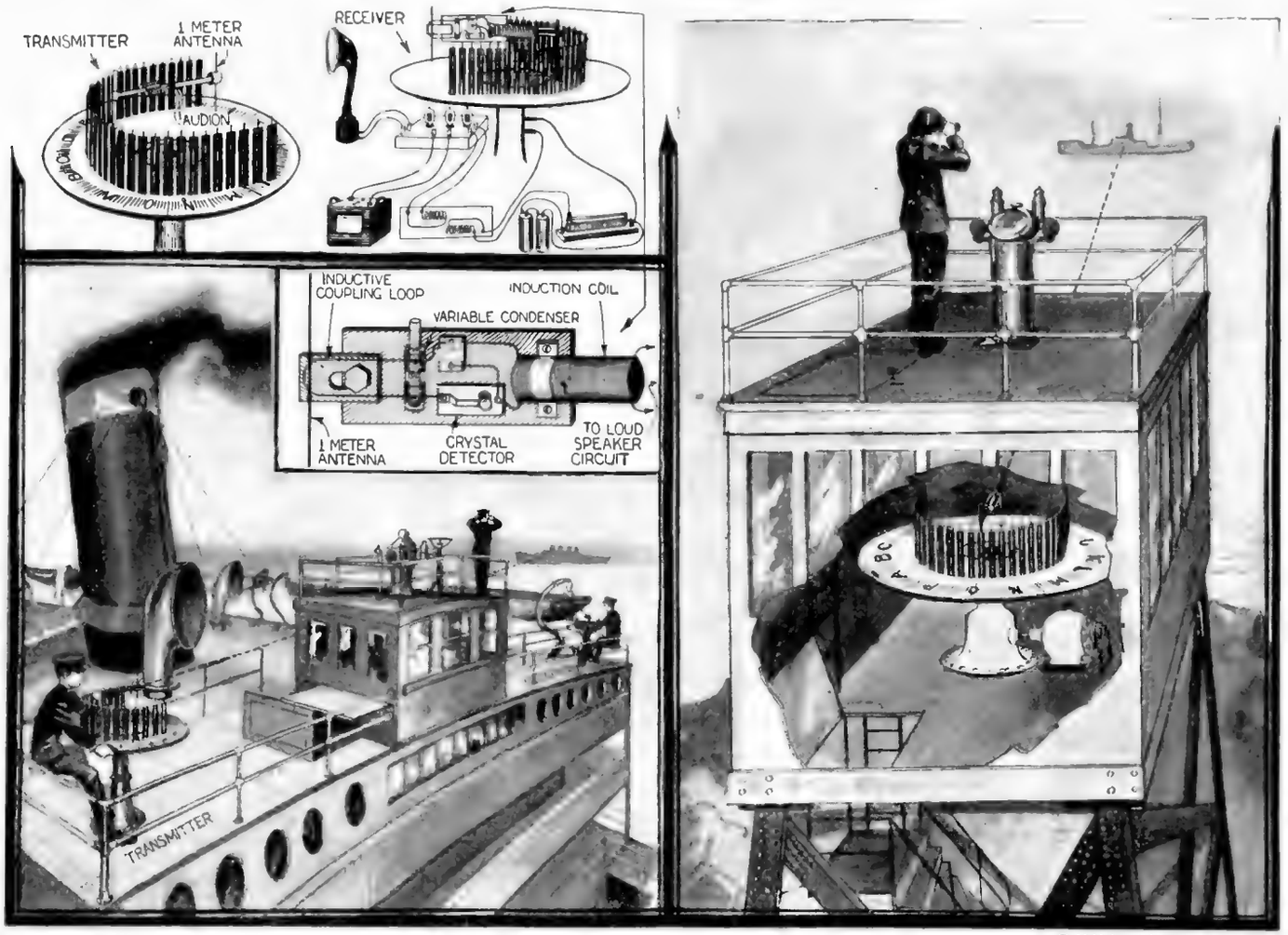
By A. P. PECK

IN a paper read before a joint meeting of the American Institute of Electric Engineers, and the Institute of Radio Engineers, Senatore Guglielmo Marconi, one of the foremost men in the development of radio communication today, told of his latest developments in the art. He said, by way of introduction, that a very great impulse had been given to his work by the discovery and utilization of the oscillating electron tube, based on the observations and discoveries of Edison, Fleming, De Forest, and others, because of the fact that these oscillating tubes may be used not only as detectors of radio waves, but also as generators of oscillations, and may be used in both sending and receiving radio messages. Power as high as 100 kilowatts in the antenna has been obtained by means of a number of these tubes connected in parallel, and it has also been possible to work with a group of 60 tubes, using voltages of 12,000 on the plate.

Of late, Marconi's attention has been turned toward the production of waves of very short length, and in his experiments with his so-called "Radio Searchlight," or directional transmitter, he has used waves but only a few inches in length. In the study of short waves he has gone back to the era of the discovery of electric waves themselves, that is, to the day of the classical experiments of Hertz, for Hertz used short electric waves in all his experiments.

These aforementioned waves have been found extremely useful in directional radio transmission, inasmuch as it is possible to make a so-called reflector, which will absorb all the waves sent out in all directions, except that in which it is desired to transmit.

During his first tests he used a spark transmitter, the primary circuit having an air condenser and the spark discharging in compressed air. The receiver consisted of a crystal detector, and the reflectors employed were made of a number of strips or wires, tuned to the transmitted wave, and arranged on a parabolic curve, with the antenna in the focus. The transmitting reflector was arranged so that it could be revolved, as may be seen from the accompanying picture.



© 1922 by Science and Invention

Senatore Marconi in a Recent Lecture in New York City Described Among Other Recent Inventions He Had Been Working on a New System of Directive Radio Transmission and Reception. The Illustration at the Left Shows How Two of His Directive Antenna Cages May be Placed on a Ship's Bridge, the Transmitter Sending Out a Directive Wave, Which When Reflected From Another Ship or Object in a Fog, For Example, Will be Reflected, and This Fact Indicated at the Directive Receiver. The Two Detail Diagrams Above Show the Directive Transmitter and Receiver, as Demonstrated by Dr. Marconi. When the Transmitter Antenna Cage Was Turned Even a Fraction of a Circle, the Signal Received Thru the Loud-Talker at the Receiving Apparatus Weakened Markedly. The Illustration at the Right Illustrates One of Dr. Marconi's Ideas for Radio Shore Towers, a Ship Locating Its Distance From Shore at Any Time by Measuring the Strength of the Signal Received.

Later on, in 1919, electron tubes were used in place of the spark transmitter, and very much better results were obtained.

Very noteworthy are the following facts: With the reflectors in use at both the transmitting and receiving stations, speech was strong, and of very good quality. It was usually strong enough to be audible with ¼ to ½ ohm shunt across a 60 ohm telephone.

(*Continued on page* 406)

Radio-Telephone and Aircraft

By S. R. WINTERS

AS far-fetched as the claim may appear on the surface, the conditions which have made possible the present popularity of the radio-telephone are due in no small measure to scientific triumphs emerging from war-created difficulties. Military strategists early recognized the superior advantages of radio-telephony over radio-telegraphy as a vehicle for maintaining communication between different units of aircraft and as a means of intercourse between formations of air-going machines and warring forces on the ground. The use of radio-telegraph transmitting outfits involved a knowledge of the Continental code, but a squadron of twenty or thirty airplanes could be readily controlled in the air thru commands issued by means of spoken intercourse.

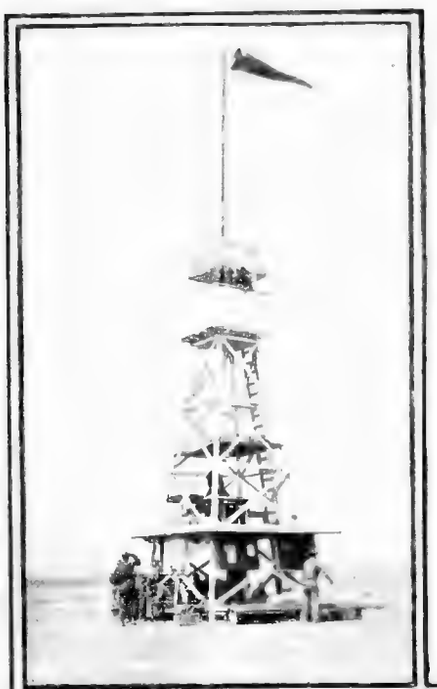
The outstanding contribution of the radio-telephone to the growth of aviation will doubtless be its ability to minimize the fatalities incident to flying in foggy weather and accidents due to collisions in the air; the toll of lives from such causes recently having a demoralizing effect on the entire aviation industry.

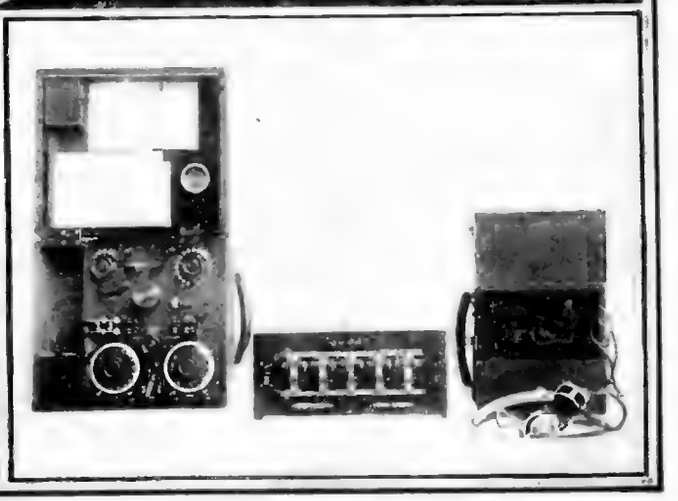
The Air Service of the United States Army recently approved of the introduction of a radio-telephone system for disseminating information relative to weather conditions to aviators in flight. Wireless stations, in the accomplishment of this end, are being constructed at Mitchel Field, Long Island, New York; Langley Field, Virginia; Moundsville, West Virginia, and at Fairfields, Ohio. The Air Service contemplates an extension of this system over the entire United States, altho at present actual construction is not in progress west of Ohio. The inauguration of this method of contact between the aviator and reliable weather forecasts, it is contemplated, will avoid a repetition of disasters similar to the one occurring near Morgantown, Maryland, when the lives of seven persons were exacted by a violent storm. The network of radio-telephone installations will afford facilities for broadcasting reports from the Weather Bureau and any storm warnings affecting the safety of aviators.

The United States Aircraft Corporation of Spokane, Washington, recently authorized the installation of radio-telephones capable of sending and receiving messages for a distance of 1,000 miles. The radio compass is also to be utilized on the aircraft of this corporation as a means of enabling the pilot, irrespective of the height at which he is soaring, to determine the location of the landing field and indicate the exact direction in which he is traveling. This Corporation is making it obligatory that pilots and students within the jurisdiction of the company obtain knowledge of radio-telephony and radio-telegraphy at the same time that the science of aircraft is being studied. All air-going machines being produced by this corporation are to carry radio-telephone equipment capable of both transmitting and receiving communications.

The Radio-Communication Section of the Bureau of Standards, U. S. Department of Commerce, has just developed a device for rendering assistance to aircraft in returning safely to earth at night, in the course of foggy weather, or under other conditions of inadequate visibility. Radio-frequency waves are employed, two horizontal coils, one above the other, with the current passing in opposite directions, constitute the vehicle for supporting the electromagnetic waves. A reasonably high wave-length, say 1,000 meters, was employed in this case. It was contemplated that wireless signals radiating from two coils would be strongest for an aircraft soaring in a specified horizontal plane whenever the air-navigating unit was within a comparatively restricted ring-shaped area located above the landing field. The theoretical conclusions on paper when translated into practice abundantly justified the virtue of the calculation. The difficulty existing heretofore was that of offering helpful assistance to an air-going machine in definitely locating the landing field when the former was within close proximity thereto, the view being marred by fog or conditions of nightfall. A method was desirable whereby wireless signals could be heard distinctly over a large area when soaring at high altitudes and could be localized within a restricted area when the aircraft was flying near the earth. A large horizontal coil tuned to 500 kilo-cycles

(*Continued on page* 411)





At Left: Aircraft Radio Receiving Station, School of Gunnery, Oneonta, Calif.

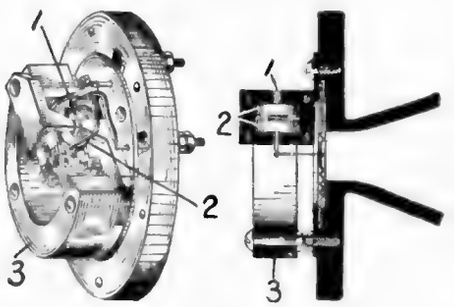
Below at Left: Receiving Airplane Radio Messages Using S. C. R. 54 Set with S. C. R. 72 Set as Amplifier.

Below at Right: Royal Air Force Wireless Telephone Set for Airplane Installation. This Set was Built by the Marconi Wireless Telegraph Co. of England. Note the Compactness.

At Right, Above: Airplane Pilot and Observer Showing Inter-Communicating Telephone in Use.

New Power Amplifier and Loud-Speaking Receiver

A WELL-KNOWN American telephone manufacturer has recently placed on the market a power amplifier and loud-speaking receiver, which is here described in detail. This has been brought out because of the widespread interest that has been displayed in the receiving of broadcasted news, music, and entertainment, by private radiophone operators. It is designed to be used in connection with a regular receiving tuner, and a detector with one or two steps of amplification. The outfit consists of a loud-speaking receiver especially designed for radio work, and a two-stage vacuum tube power amplifier, equipped with three special vacuum tubes, connected as shown in the accompanying diagram.

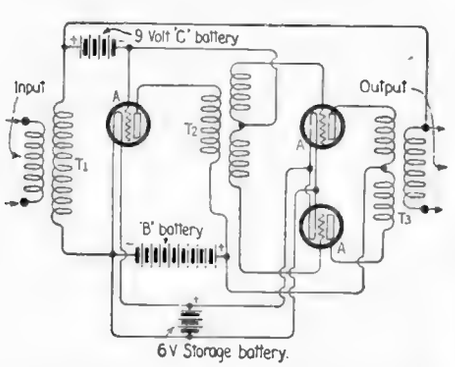


This View of the New Radio Loud-Speaker Here Described Clearly Demonstrates Its Simplicity, No Large Separately Excited Field Magnets Being Necessary. The Moving Armature is Linked by Means of a Delicately Pivoted Lever System to a Corrugated Diaphragm of Iron, or in Some Cases Bakelite.

The makers claim that this set, when used in connection with a well designed vacuum tube receiving set, and supplied with the necessary current, will reproduce all forms of music and speech with wonderful clarity and quality of tone, sufficient to fill public halls and theatres of medium size.

The tubes employed with this set are especially designed for the circuit used. They make use of a special oxide coated filament which insures maximum electron emission with minimum filament temperature. The tubes, when in operation, glow dull red, which feature insures long life and minimum filament power consumption.

The amplifier unit consists of a wooden cabinet, measuring approximately 12½"x 10"x4½", which carries a panel of insulating material. Upon this panel are mounted a switch, of the push and pull type, to control the filament current; a five point switch to control the volume of sound; sockets for the three special vacuum tubes, and the necessary binding posts for connections.

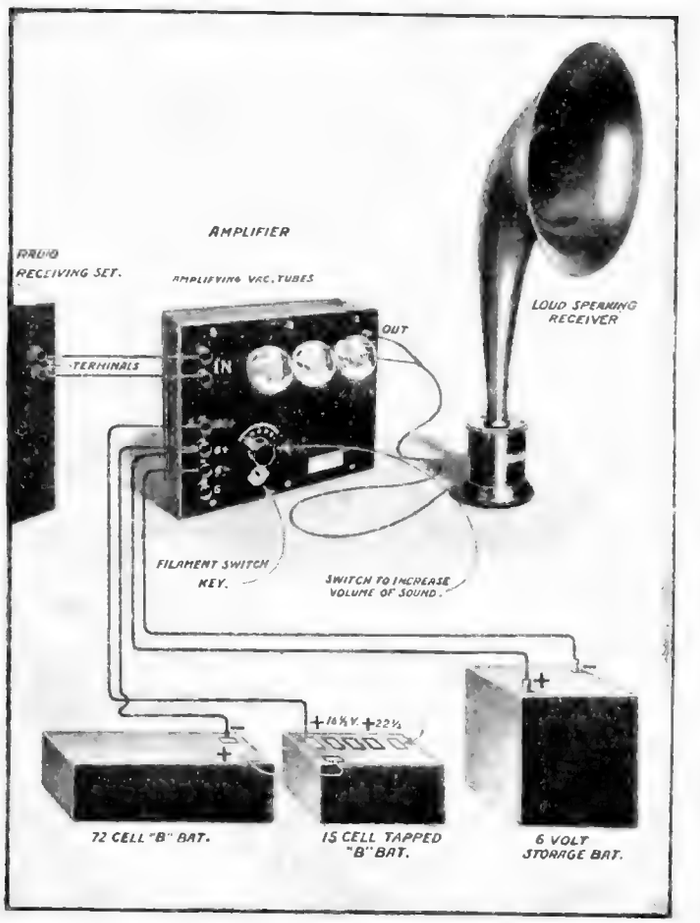


The Schematic Circuit Here Shown For the Radio Loud-Talker Gives a Clear Idea of the Electrical Circuits Employed For the Three Power Tubes and Special Tapped Transformers, "C" Battery, etc.

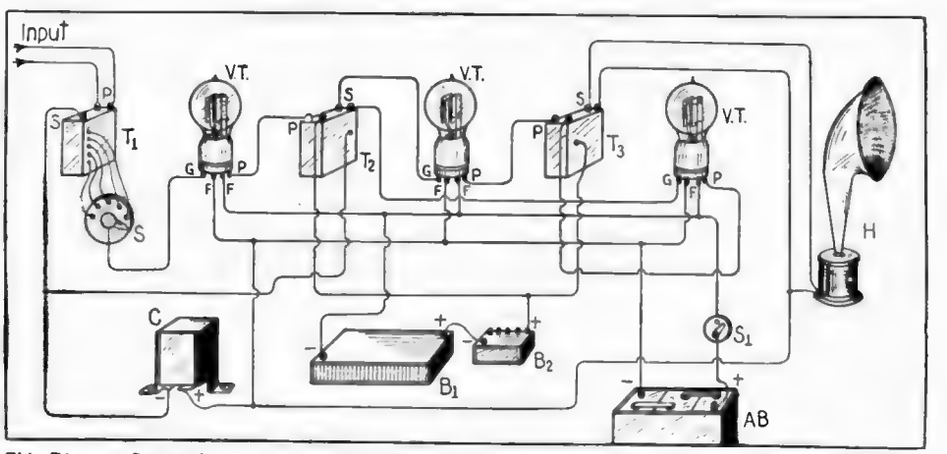
The circuit of the amplifier is unique in that it employs three vacuum tubes for two steps of amplification. As may be seen from the accompanying circuit diagram, the volume of sound is controlled by cutting in more or less of the first amplifying transformer secondary, by means of the five point switch. The second and third tubes are connected in parallel, and each receives its plate voltage thru half of the primary of the third transformer. The circuit of these two tubes is of the balanced or "push pull" type so that each tube is required to handle only one-half of the energy delivered to the receiver. This circuit increases the operating margins of the outfit and reduces distortion to a minimum. A "C" battery with a potential of nine volts is used to impress a negative biasing charge on the grid. A plate voltage of 120 volts is used and a filament voltage of six volts.

The loud-speaker itself is of the pivoted armature type, actuated by magnets with a resistance of 325 ohms, and connected by means of a rod to a corrugated diafram, made of soft Norwegian iron. This construction may be readily seen from the accompanying cut. The entire receiver is mounted in a metal housing and used with a curved horn especially designed to give adequate volume and pure tone.

The two units, that is, the amplifier cabinet, and the loud-speaking receiver, are especially designed to be used together and to give a maximum volume of sound with a minimum distortion, whose success the editors can testify to, as they have heard several of these outfits in operation. A special feature is that no storage battery current is consumed in exciting a field magnet.



This Photo-Diagram Shows the Latest Type of Radio Loud-Speaker Which Is Remarkable For Its Clarity of Tone and Freedom From Howling and Frying Noises. The Loud-Speaker Shown Requires No Separately Excited Field, a Special V. T. Amplifier Cabinet Being Used With It, However; This Cabinet Containing Three Special Power V. T.'s, Besides the Necessary Transformers and Control Switch.



This Diagram Shows the Connections Used With the New Radio Loud-Speaker Illustrated in the Accompanying Photo. The Transformer T2 Has a Tap From the Center of the Secondary, While the Transformer T3 Has a Tap From the Center of the Primary Winding. This Power Amplifier Circuit Operates on What is Called the Push-Pull System, and It Gives Very Excellent Results Indeed; Great Stability and Freedom From Howling Being Two of Its Outstanding Features.

Radio Concerts for Lighthouses

By E. M. STEVENSON

OUT beyond the ken of our civilized world on the dreary wastes of coast and islands where stand the lonely sentinels, mute and sleepless guardians of all those that go down to the sea in ships, our lighthouses, those tall, monumental structures, rear their heads into the clouds and defy the elements to overturn them.

These bleak, but useful and indeed absolutely necessary instruments for the safety of our ocean traffic, are tenanted by sturdy, faithful and intrepid men who watch and keep in condition the lights, bells, and fog horns that they may never fail in the duty they are there to perform.

At last their faithfulness is to be rewarded. The great strides that have been made in radio in the last few years, particularly in wireless telephony, have caused the government, which has long wished to better their condition and has provided them with books and magazines, to decide to install radio telephones in the lighthouses, to relieve the monotony of the dreary watches thru weeks and months of isolation.

An intensive campaign to this end is being launched by George R. Putnam, Commissioner of Lighthouses.

Commissioner Putnam stresses the fact that the average land dweller has no conception of some of the remote places where these lighthouses are situated and to which he is trying to bring relief. The keepers of the Alaska lighthouses, at the entrance to Behring Sea, remain at their posts for three years at a stretch. Only every fourth year do they get a vacation. At Tillamook Rock Light, on the Pacific coast, just south of the Columbia River, bad weather has prevented communication with the coast for seven weeks at a time. Some of the Alaskan keepers have been without mail for ten months.

With the co-operation of the Navy Department, radio telephones have been installed in some of the remote lighthouses of Alaska.

$100.00 Prize Contest

For Best Home-made Loud-Talkers

WE announce herewith our $100.00 prize contest, open to all radio bugs, for a description and photograph or drawing showing how they built a simple and efficient loud-talker for use on their radio set. At the present time a great wave of enthusiasm over radio, especially radio in the home, has settled down to the proposition of amplifying the incoming speech sufficiently to operate a loud-talker, so that everyone in a fair sized room can hear it without wearing head phones. There are several distinct varieties of radio loud-talkers on the market at the present time, but most, if not all, of these are of too difficult design and construction for an amateur radio man to build, unless he happens to be quite a fair machinist, or has some of the parts made in a machine shop.

Quite possibly the successful loud-talkers which the prize winners will show us may require that some of the parts be made in a machine shop, or else turned on a lathe in the home laboratory. Some of these problems may be simplified and overcome, however, by adapting stock parts available on the open market.

One of the simplest loud-talkers now in use comprises a Baldwin amplifying receiver attached to a large horn, but as several different varieties of this simple form of loud-talker were described some months ago in this journal—as well as in RADIO NEWS; and, furthermore, as this arrangement does not involve any special design or new idea, but simply the mechanical connection of a radio receiver to a horn, such an idea will not be of any avail in endeavoring to win one of the prizes here offered.

To sound the key-note of what we are after and expect from contestants for the various prizes, we have in mind one form of loud-talker supplied with a powerful field similar to that used, for example, in the Magnavox and Vitaliphone, this field having its windings excited by current taken from a separate storage battery, from dry cells, or from the "A" battery supplying the filaments of the audions on the receiving set.

As radio fans everywhere have no doubt noticed, the general trend of design in loud-talkers has now been focussed on the elimination of the separately excited field, which usually necessitates the extra cost and maintenance trouble of a second independent storage battery, from that used for lighting the audion filaments. Therefore, it is very desirable indeed to design a loud-talker which shall be efficient, and this means one of these two things; either that the necessary magnetic field shall be supplied by permanent steel magnets or by field coils requiring a small current.

FIVE PRIZES IN LOUD-TALKER CONTEST

First Prize	$50.00	in gold
Second "	20.00	" "
Third "	15.00	" "
Fourth "	10.00	" "
Fifth "	5.00	" "
Total,	$100.00	

The most important rule in this contest is that we shall require the contestants to send in a model of the loud-talker, or if this cannot be done, a letter showing that the instrument has been inspected and successfully demonstrated before a reputable engineer or municipal officer in your home town or city will suffice, and this letter should be sworn to before a notary.

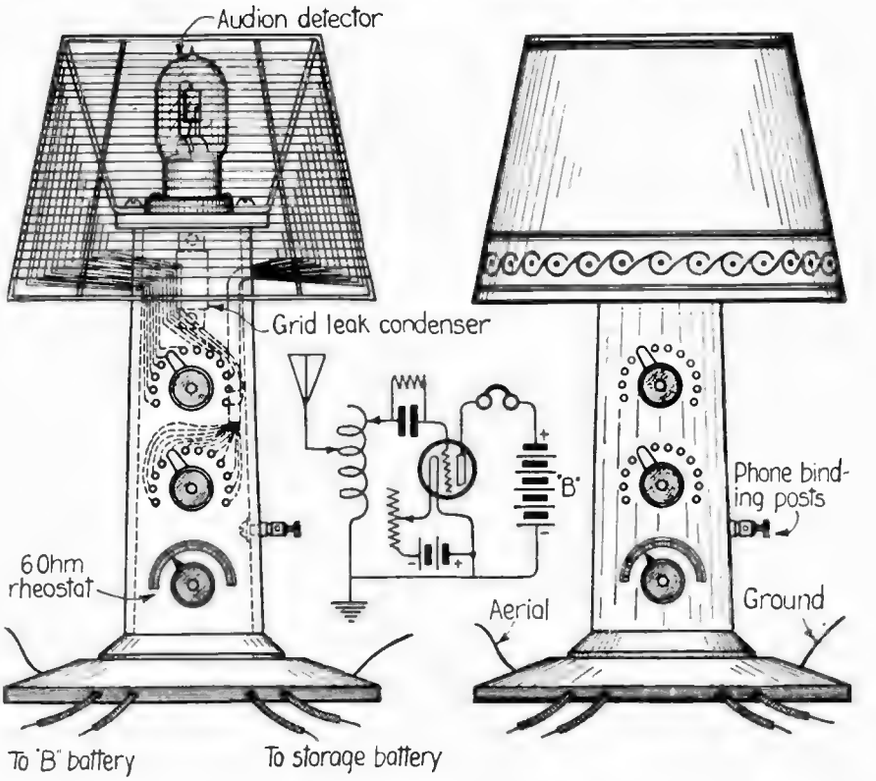
A short description of not over 500 words, together with a sketch showing constructional details and a photo if possible, are desired. No manuscripts entered in this contest can be returned, and we reserve the right of paying regular space-rates to publish all worthy ideas which do not win a prize. Use ink, not pencil, in writing articles and make sketches on separate sheet. This contest is open to everyone, including radio clubs, excepting radio manufacturers.

This contest closes at noon, September 25th. Should two contestants submit the same idea, the same prize will be paid to both. Don't wait till the closing date to send your idea or model in, but get busy right away, in order to relieve the work of the judges. Address all communications to—*Editor, Radio Loud-Talker Contest*—in care of this publication.

Radio Set in a Table Lamp

This lamp is more adapted for radio than for lighting purposes, but it will give sufficient light to enable a person to read. The hook-up shown in the illustration will receive radio-phone concerts within the wave length of the tuning coil, and the latter is wound with No. 24 cotton covered magnet wire around a lamp shape frame. When the wire is wound and the taps soldered, etc., put the cloth back on the frame, thus covering the wire. The grid leak is one-half to six megohms, and the grid condenser is .00025 M. F. The rheostat has a resistance of six ohms. The radio-tron detector bulb produces quite a bright light. The "B" battery should be 22½ volts, and the "A" battery should be 6 volts, and the phones of 2,000 ohms resistance. When all the connections are soldered in good order, the set is ready for use. Even a crystal detector set made in this fashion, with a regular lamp built on top of the standard, provides a distinct novelty.

Contributed by
EDWARD E. YOUNG.



Now that the Radio Manufacturers Are Rapidly Growing Out of the Stage Where Any Old Cabinet Was Good Enough to Mount the Instruments in so Long as They Worked, This Idea Advanced by Mr. Young Will Appeal to Many. Mr. Young Has Built a Complete Audion Receiving Set in a Wooden Table Lamp, and if the Pedestal is Made of Fair Size, Even the "B" Battery Can be Incorporated Within it; the Storage Battery and Phones Being the Only External Apparatus, Connections to These Parts as Well as to Aerial and Ground Can be Made by Means of Silk Covered Flexible Wire.

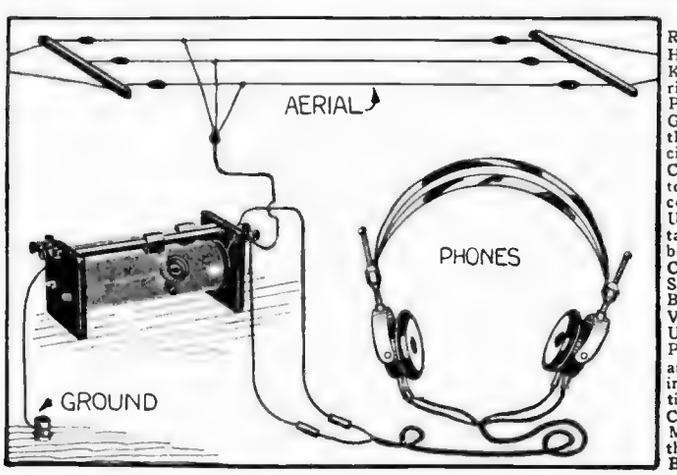
The Detectorium--A Combined Detector and Tuning Coil

A CLEVER combination of detector and tuning coil slider is incorporated in the apparatus shown in the illustration herewith, and it has been named the *Detectorium* by its inventor, Mr. H. Gernsback, who owns the patents on it. The Detectorium comprises a double slide tuning coil sufficient for wave lengths up to 600 meters with the average sized aerial, together with a crystal detector employing preferably a sensitive pointed piece of silicon. In the original instrument tried out by Mr. Gernsback successfully, the mineral (silicon) cup was not resiliently mounted with a spring, but this feature would be desirable, especially if other minerals, such as galena, happened to be chosen. This complete receiving set, exclusive of head phones, weighs but eighteen ounces, or with a pair of head phones, together with some aluminum aerial wire, the whole outfit will not weigh more than two and a half pounds.

The unique part of the instrument lies in the detector arrangement, which makes use of a piece of silicon or other suitable mineral, such as iron pyrites (Radiocite) fastened to a spring protruding from one tuning coil slider, as can be seen from the illustration. By using this crystal as a contact point for the slider simultaneously, the mineral rubbing against the bared convolutions of the coil, the inventor makes it possible to actually tune with a detector. The instrument was tried out in the laboratory and proved surprisingly efficient.

There are many different ways in which the Detectorium can be connected with the head phones or variable condensers, but the diagram below was found to be one of the best arrangements tried out, especially where there is much static or interference to eliminate. It will be advisable to add a buzzer test to this receiving set, so as to know when the detector is at its most sensitive adjustment, and a small two-cell flashlight battery, including buzzer and push button, could very well be placed inside the tuning coil tube, a small door or panel being arranged in the end of the coil, so that the battery could be renewed when necessary. A small push button can be mounted right on the end of the coil. In tuning in signals with this apparatus, it was usually found best to move the detector slider, that is, the mineral pointed slider, until the signal came in the loudest; and then to move the ground wire slider until the signal was heard with maximum intensity. In this way, the necessity of moving the detector slider after the signal had been heard, and thus disturbing the detector sensitivity, was eliminated to a large extent.

The general trend of radio development today is along the line followed by Mr. Gernsback in designing the *Detectorium*, or in other words, the principal aims have now become simplicity and compactness. At the Radio Shows held in the past months in New York and other cities, some very amusing and albeit interesting radio receiving sets have been exhibited and demonstrated. Some of these are really marvels of radio technique and design. One of the small sets exhibited was arranged on a lady's garter, and a fair damsel wearing one of the knee length modish skirts of the moment demonstrated the apparatus in actual use, a very nifty idea for use during shopping and elsewhere. The principal point to be watched in building a small compact and simplified radio receiving set is to have a good sensitive detector, and there is considerable room for improvement in this direction. Anyone can assemble some sort of freak apparatus which may be a novelty of course, but that is not the final result that the real radio enthusiast is after—he wants efficiency above everything else.

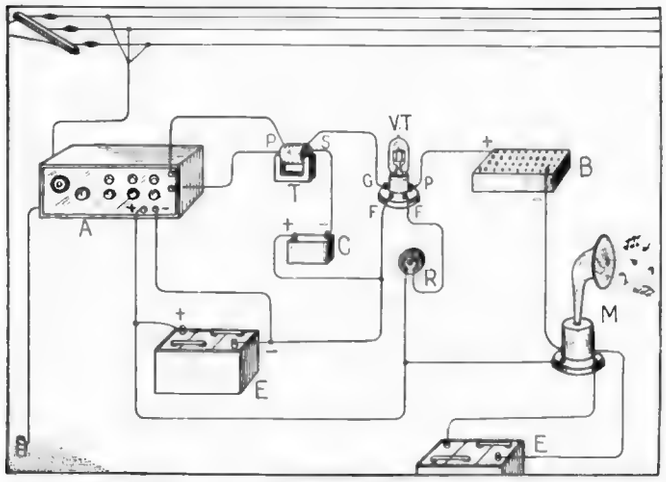


The Simple Compact Radio Receiving Set Here Illustrated is Known as the "Detectorium," and Has Been Patented by Mr. H. Gernsback, the Editor of this Journal. Its Principal Novelty Lies in the Combination of a Detector Slider, a Piece of Silicon, for Example, Being Used for the Slider Contact, as the Latter Member is Moved Along the Coil. The Circuit Here Shown is a Simple One, But Those in Which Variable Condensers Are Used Will of Course Provide Finer Tuning and Selectivity for Weeding Out Unwanted Stations, Etc. A Fixed Condenser, if Desired, May be Placed Inside the Tuning Coil, also a Buzzer Test and Battery.

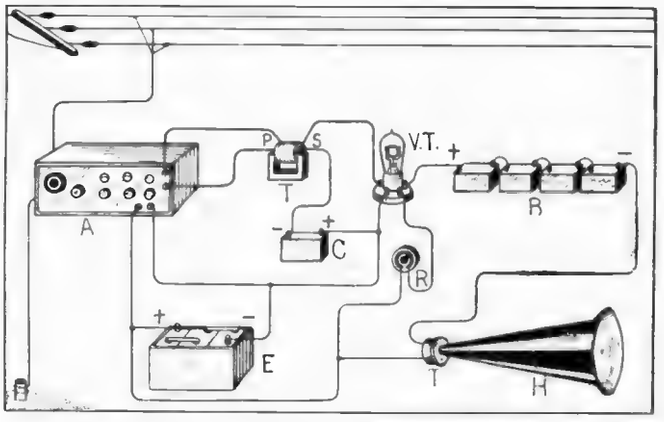
Radio for the Beginner

By ARMSTRONG PERRY

NO. 6—HOW TO GET MORE SOUND OUT OF A RADIO RECEIVER



If You Already Have a Detector and Two Steps of Audio-Frequency Amplification, You Will Find This Circuit an Excellent One For Boosting the Strength of Signals Sufficiently to Fill An Entire Room or Small Hall. An A. F. Transformer T is Connected With a U. V. 201 Amplifying Tube, With a C Battery in the Grid Circuit and Filament Rheostat R. The Battery B Should be a 200 or 300 Volt Unit, and the Loud-Talker M Either a Magnavox or Other Efficient Instrument. If the Loud-Talker Requires an A Battery, This May Be the Filament Battery, or Preferably a Separate One, as Shown.



A V. T. Detector and 3-Step Amplifier Does Not Always Give as Much Power in the Loud-Talker as One Would Wish, But the Arrangement Above, Also the One At the Left, Have Been Used By Mr. Secor, of the Editorial Staff of SCIENCE AND INVENTION, With Very Good Success, the Principal Point in Both of These Hookups Being That a Separate B Battery is Employed For the Third Stage of Audio-Frequency Amplification to Eliminate Howling. An Optional C Battery in Either Case May Be of 10 to 20 Volts Potential, and Usually Helps to Stabilize the Circuit Also and Prevent Distortion. A Loud-Talker H Above Comprises in Mr. Secor's Case a Sheet Metal Horn 3½ Feet Long, With an 18-Inch Bell, Together With a Baldwin Type C Amplifying Receiver T. E is the Common Storage Battery Lighting All the Filaments. "B" Battery 90 Volts.

THE radio novice who builds or buys a receiver, hooks it to an aerial and a ground wire, and explores the ether is thrilled at first if he hears anything at all. If the sounds are faint he yells at the family until he reduces the household to a deathlike stillness. He considers any radio sound that can be understood as satisfactory.

Then comes a reaction. Even the best regulated wife and children can only be held in subjection about so long. If they cannot hear what the radio set is bringing in, at least they want to be allowed to go ahead with their normal activities. The novice gets tired of straining his ears also. As he acquires skill in the operation of his receiver he secures better results, but sooner or later he wearies of the head phones and the grouchy glances of those who want to share the sport, and begins to cast about for something to increase the volume of sound.

If he has a crystal detector he may as well accept the hard fact that he will be able to increase the sound to only a limited degree. By going over his antenna, receiver and ground connection, as suggested in Article number four, in the June issue, he may be able to discover a number of little things that reduce the strength of the sounds that he hears.

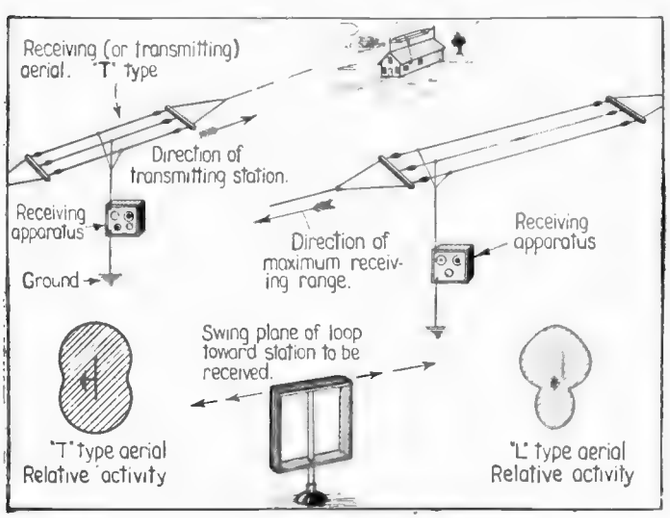
Near-by metal roofs, eave spouts, fire escapes and other masses of metal may be absorbing some of the radio waves that otherwise would increase the current flowing in the antenna and the sound vibrating in the phones. Get the antenna away from them as far as possible. To let a radio wave pass a good electrical conductor on its way to your antenna is like sending a boy to Sunday School past a baseball diamond. It may get there but the chances are against it.

Changing the direction of the antenna may increase the sound at the receiver. If it is built like a "T," the ends should point toward the stations that the operator most wants to hear. If it is like an inverted "L," the elbow where the flat-top and the lead-in wire join should point toward the sending station for the loudest results. There seems to be a funny-bone in such a joint as sensitive as the one in the operator's elbow. A tickle there gets more action than a slap on the free end.

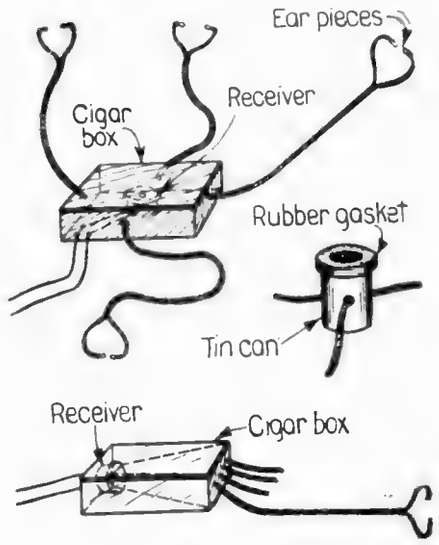
If the current received is strong enough, two or more phones can be attached to one receiver. They should be in series, so that the current will travel from one phone connection on the receiver to the first phone, through that to the second phone, and so on back to the other connection on the receiver. To connect both tips of both phone cords directly to the binding posts on the receiver is to divide the current and give each pair of phones only half of it, but running the juice through one and then the other gives both the benefit of all of it, with only such diminution as is caused by the resistance of the wire. It is like two children with one stick of gum. If they break it in two and each takes half neither will have a good-sized cud, but if they take turns at chewing the whole gob they have more of a mouthful.

By placing a single phone, or a pair in a sound chamber such as an empty cigar box, and inserting rubber tubes in holes in the box, the sound may be led directly into the ears of a number of listeners and a dozen persons can hear as easily as one. Hard rubber tips in the ends of the tubes make hearing easier.

(*Continued on page 374*)

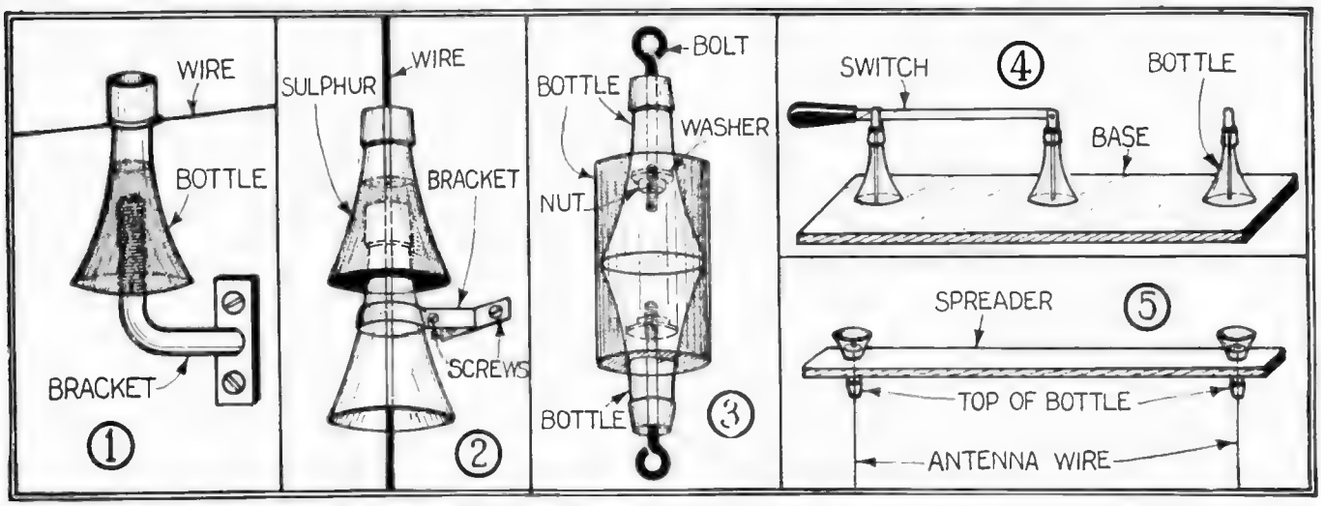

Receiving (or transmitting) aerial. "T" type
Direction of transmitting station.
Receiving apparatus
Ground
Direction of maximum receiving range.
Receiving apparatus
Swing plane of loop toward station to be received.
"T" type aerial Relative activity
"L" type aerial Relative activity

Glancing at the Two "Relative Activity" Charts in the Lower Corners of the Illustration, these Show in Which Directions the Maximum Strength of Signals are Received from or Transmitted to, Looking from the Top of "T" and Inverted "L" Aerials. In the Case of the Inverted "L" Antenna, it is Seen that it Transmits and Receives Best in a Direction Opposite to that of the Free End. The Plane of a Loop Aerial Should be Turned in Line with the Station Being Listened to.



A Cigar Box Fitted with Several Rubber Tubes and Ear Pieces, as Shown at the Right, Makes it Easy for Several People to Listen to a Radiophone Concert, Where a Fairly Strong Response is Obtained in the Phones.

Insulators from Bottle Necks



Old Bottles Lying About the Cellar are Not Always to be Despised, Especially When we Need Insulators for Aerials, Lightning Switches, etc. Several Good Suggestions are Illustrated Above for Making First Class Insulators from Old Bottle Necks. Bottles May be Cut in Half by Tying a String Saturated with Kerosene or Gasoline Around the Bottle, Igniting It, and When About Out the Bottle is Plunged into Cold Water, Causing It to Snap Off Evenly.

The following are several types of insulators, which may be made from bottle necks.

No. 1 is a single petticoat insulator, mounted on a bracket. The mouth of the bottle is stopped up with paper, and the screw part of the bracket plays in the other end to the proper depth, after which some insulating compound, such as sulphur or tar, is poured in to hold the bracket in place.

No. 2 is a type of insulator in which the wire passes through the center. The bottles are fastened together by placing one inside the other, and filling the spaces with an insulating compound. A clamp is then used to hold the insulator to the building, as shown in the diagram.

No. 3 is a strain insulator. The two bottle necks are placed in a straight glass section, cut from a bottle, and the spaces at each end are filled with insulating compound. Before assembling, eye-bolts are fastened in the neck, as shown in the diagram, by means of a washer and a nut.

No. 4 shows how bottle necks may be used for supporting the jaws and switch arm of a lightning switch. They are fastened by passing the bolt down into the neck of the bottle where it is held securely with a washer and nut. A bolt is also passed up through the base, and the insulator is fastened over it by filling with insulating compound.

Figure 5 shows another variation for using the bottles as insulators on the spreaders.

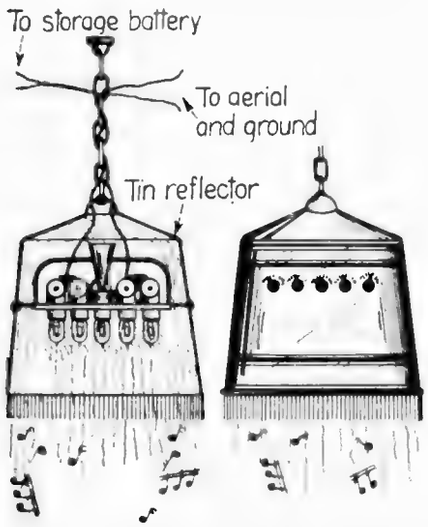
The necks can be cut from the bottles by any method, many of which have been described in past issues of SCIENCE AND INVENTION, after which the edges are filed or ground smooth.

Read by Audion Light

Nowadays, when radio experimenters think nothing of using half a dozen audions or vacuum tubes in their amplifying receiving sets, I have often thought of killing two birds with one stone, as the old saying goes, by not only listening to delightful music via the radiophone every evening, but also putting to good work the light from the audion bulbs. The accompanying illustration shows my idea clearly.

Of course there are many possibilities to this scheme, and if it is properly worked out, the lamp shade, which may be made of metal, fibre or wood, will be quite a large affair, let us say, and in an upper compartment hidden by a false partition, on which the audions and their sockets are supported facing downward, we could have the necessary transformers, rheostats, etc., with the rheostat handles projecting from the side of the shade, so that we could adjust the audions as required. Then why not place a loud speaking phone, such as a special amplifying type C Baldwin receiver in the top of the horn-shade and project the radiophone music, speeches, etc., downward and out of the amplifying chamber thus constituted? The "B" batteries and storage battery could be placed under the table, or in the ceiling through a pocket in the floor above, and the wires brought down along the chandelier chain or pipe. Perhaps some furniture designer will awake to the novelty of this suggestion and one of these fine days we shall be agreeably surprised to hear mysterious "music" and "talk" emanating from one of those innocent-looking silk-domed piano lamps.

Contributed by H. W. S.



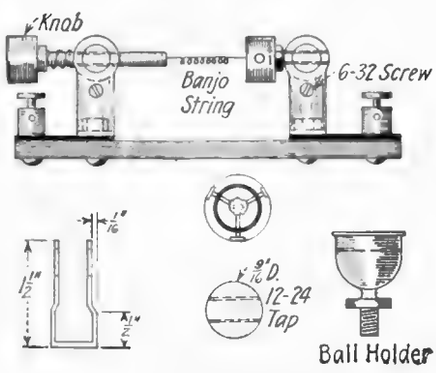
If You are Using Several Audions, Here is a Suggestion Which May be Worked Out in Different Ways for Utilizing the Light from the Audions to Read by. This Idea Involves Placing the Tuning Apparatus, Transformers and "B" Battery Inside the Metal or Glass Dome, the Sound from the Loud-Talker Being Reflected Out of the Dome in the Manner Illustrated

CRYSTAL DETECTOR

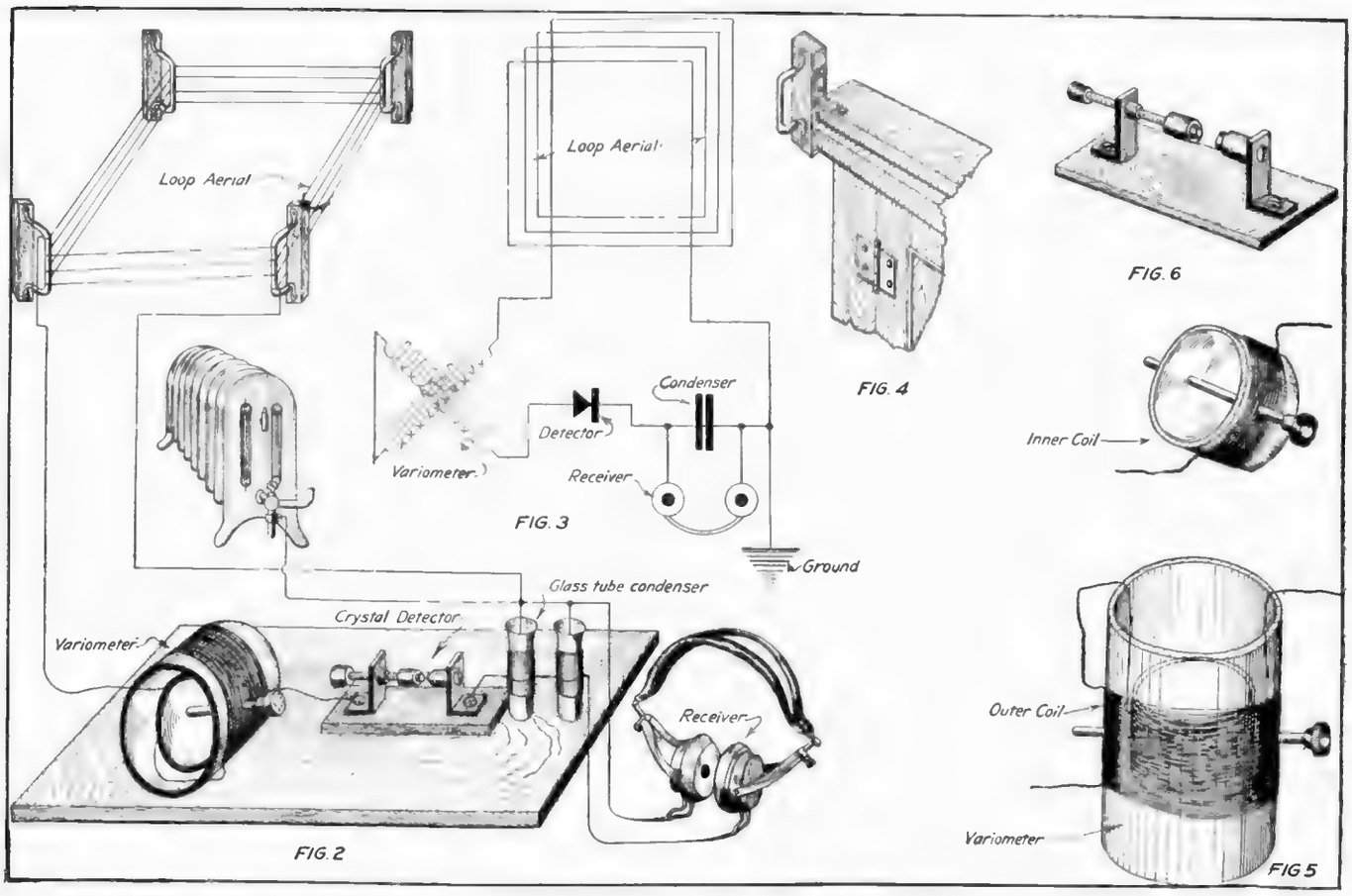
Usually a crystal detector is quite expensive when the purchaser is looking for something unique. Of course, manufacturers have reduced the cost of such detectors to such a point that no radio amateur should be without one, but occasionally the amateur desires to build one himself. Here is a description of a crystal detector which has very wide range of contacts, and is extremely adjustable. The ball holder is merely a small oil cup, which has been cut off near the top, as indicated by the dotted lines in our diagram. A ball, preferably of brass, having a hole drilled through it and tapped to receive a 12-24 screw, is then placed in the holder, which should be clinched over slightly. A screw and cup are then attached to one side of the device. On the other side, the ball joint differs but very slightly, as is clearly illustrated in our diagram. A steel banjo string acts as the cat whisker. The remarkable utility of the device is the fact that if the crystal is to be changed, the crystal cup is merely moved into a vertical position. A spring may be placed around the stem or screw connecting with the banjo string, or, in other words, the cat whisker adjusting screw. The whole when mounted upon a fibre or hardwood base and provided with the necessary binding posts, makes a very serviceable detector.

Contributed by O. E. BRICKER.

Crystal Detector



A Very Good Design of Crystal Detector is Here Illustrated, One of the Principal Points to Watch in This Class of Detectors Being the Continuity of Contact Between the Binding Posts and the Upright Standards Which Support the Contact Spring and Mineral Cup. It is Always Best to Solder a Piece of Flexible Lamp Cord to Any Moving Parts on Radio Instruments, and Then Solder the Other End of This Cord to Some Stationary Contact Member. Minerals May be Held in the Manner Illustrated, by Screws, or Else Mounted by Means of Wood's Metal, Dental Amalgam or Hugonium Alloy.



The Winner of the Fourth Prize of $25.00, Mr. J. T. Lansing, in Our "Simplest Radiophone Receiver Contest," Conducted Some Months Ago, Submitted the Radiophone Receiving Set Here Illustrated and Described. It Can be Built Within the Cost Originally Specified of $3.00. Either a Galena or Perikon Detector May be Used, the One Here Shown Being Adapted to Hold the Two Crystals of a Perikon Set. A Loop Aerial Extending Around the Room as Shown Was Employed Successfully With This Receiving Set by Mr. Lansing.

Simplest Radiophone Receiver

By J. TWICHELL LANSING

(WINNER OF THE $25.00 FOURTH PRIZE)

THE accompanying illustration shows my homemade receiving set, with which I am receiving from my home in Montclair, N. J., radiophone broadcasting from WJZ at Newark, and also time signals and miscellaneous radio-telegraph stations.

The main components of the set are as follows: Indoor loop type aerial. Homemade variometer coil. Home made crystal detector. Home made "stopping" condenser (not essential but desirable). Receiver (purchased).

AERIAL. This consists of four turns of copper wire, strung around a room of about ten feet square. Any scrap copper wire will do, provided the ends are carefully scraped bright when spliced. If new wire is purchased, a one pound spool of No. 20, bare or enameled, should be plenty for the whole outfit. For mounting the wire, I screwed a small iron angle to the top of the cornice in four places in my room as near as possible to the corners. To each of these angles I then screwed a piece of 1"x 2" wood, vertically. See Fig. 4. This gave me four supports for my wire without marring the woodwork of the room. I next found some pieces of heavy iron wire—about the size used for croquet wickets. By experiment I found the right length and slipped over each a piece of old rubber hose which had once been used for a gas heater.

VARIOMETER. This consists of two pasteboard cylinders, one inside the other and each wound with 20 turns of wire. The two coils are connected in series and the inner one is simply rotated on a spindle which is perpendicular to its axis when it is to be turned. I laboriously made myself a double slide tuning coil but found the variometer described superior as well as much easier to make. I took a cylindrical paper *"Quaker Oats"* box four inches in diameter as the outer cylinder. Five inches from the bottom, I punched two holes opposite each other. I then wound ten turns of wire above and ten below these holes, tying the ends through holes to keep the turns in place. The inner cylinder is a piece of cardboard tubing, two inches long and three inches in diameter. I tacked inside of this a piece of wood as wide as the inside diameter, see Fig. 5, and, after locating screw holes in the wood, on opposite sides and midway between the ends of the cylinder—I wound ten turns of wire on each side of these holes. This insured the inside coil being located inside the outer coil. To assemble, I merely placed the smaller cylinder inside the larger and put long wood screws through holes punched. One end of the outer coil is connected to an end of the inner. The remaining two leads are connected to aerial and receiver as shown. To tune, rotate the inner cylinder on the screws as an axis.

DETECTOR. My *Perikon* set enables me to receive for a week without touching the detector. This consisted of a flat piece of zincite and a pointed piece of copper pyrites. These were mounted with Wood's metal in short pieces of copper tubing, about the size of thimbles.

CONDENSER. This is not essential, but improves the clearness of the receiving when of the proper value. Several condensers can quickly be made from wide-mouth olive or pickle bottles of various sizes and some pieces of tinfoil. Roll a piece of tinfoil on a pencil and thrust it inside. Then work it around so as to coat the inside smoothly all around. Coat the outside of the bottle with adhesive and put on a jacket of tinfoil. The lead from this part is simply twisted tightly around the outside of the neck.

RECEIVER. This probably be purchased second-hand.

GROUND. I simply filed a bright place on the steam radiator pipe in the room, and wrapped bare wire around it.

Features in August "Radio News"

Radio-Telephotography.
By Dr. Alfred Gradenwitz.

Marconi Presented With Radio Institute Medal of Honor.

A. C. Rectification for C. W.
By E. T. Jones, A. I. R. E.

A 200-Watt A. C. Radiophone Transmitter. By I. R. Lounsberry.

The Armstrong Super-Regenerative Circuit.

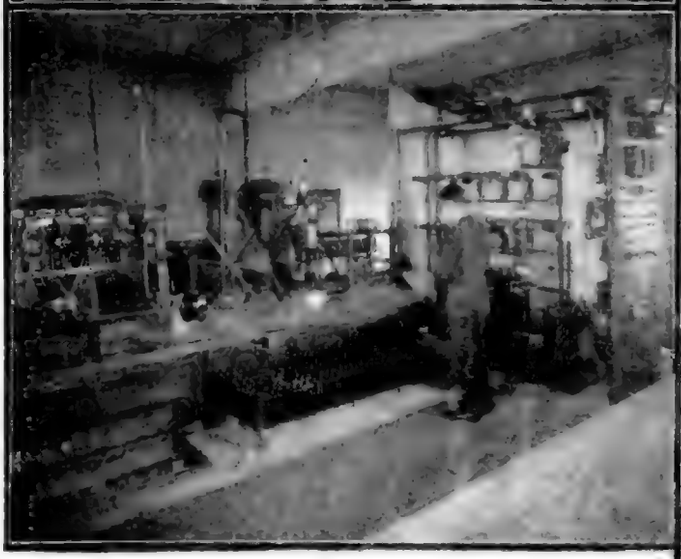
The Electron Theory Simplified.
By Edward T. Bicak.

THERE are so many broadcasting stations which have forwarded information, that we regret we have only space enough to print a very few. Those stations which have been courteous enough to submit photographs, will find that the photos will be published in due time. The stations listed on this sheet will not be published in the next issue. We would suggest to our readers that the map locations indicated on this page are for the special supplement map given free with the May issue of SCIENCE AND INVENTION. At a great expense this list of the stations has been practically completed as far as commercial broadcasting stations are concerned. We will present our readers with additional information on the new stations as it is brought to our attention. Address all communications to Editor Radio Broadcast, c/o SCIENCE AND INVENTION MAGAZINE, New York City.

Call Letter	Name	City	State	Wave Length	Map Location
AGI	Presidio of San Francisco Signal Corp., U. S. A., Sunday, 7-9 P. M., Radio Instruction. Consistent range, 50 miles.	San Francisco,	Calif..	360-1450	0-3
CFCB	Daily Province. Daily, except Sunday, 8.30-9.30 P. M., news, concerts and weather.	Vancouver,	Canada..	440	
CFCF	Marconi Wireless Tel. Co. of Canada, Ltd. Daily, 1-1.30 P. M., concert. Monday-Thursday, 8-9 P. M., concert.	Montreal,	Que., Can.	440	
CHCB	Marconi Co. Tuesday, 8-10 P. M., concert. Consistent range, 500 miles.	Toronto,	Canada.	440	
CHVC	Metropolitan Motors Co Daily, except Saturday and Sunday, 5-5.30 P. M., news and concerts. Consistent range, 200 miles.	Toronto,	Canada..	410	
CJCD	T. Eaton Co. Daily, except Saturday and Sunday, 4-4.30 P. M., concert. Saturday, 12-12.30 P. M., concert. Range, 200 miles.	Toronto,	Canada....	410	
CJNC	Tribune Newspaper Co. Daily, except Sunday, 12-2.00 P. M., markets and news. 7.10-7.30, concerts, baseball. Saturday, 2-3 or 3-4 P. M., Kiddies' hour. Sunday, 3-4 or 4-5 P. M., sacred music. 8.10-8.30 P. M., concert.	Winnipeg,	Canada...	420	
DD5	Fitzsimmons General Hospital. Concerts Thursday from 8.00 9.30 P. M. Daily news at 8.15 P. M. Maximum range 1500 miles.	Denver,	Colo.....	325	0-20
CHBC	The Morning Albertan Maximum distance heard 800 miles.	Calgary,	Alberta, Can.	410	
CKCE	Canadian Independent Tel. Co. Station operated by Toronto, Ontario Newspaper, daily 7-8 P. M., bedtime stories, music, news, financial reports, baseball scores. Consistent range, 150 miles.	Toronto,	Ont., Can...	450	
DM4	U. S. Army Station.	Kelly Field,	Texas..		AB-25
KDC	Illinois Pipe Line Co. No broadcast.	Laramie,	Wyo.		M-19
KDEP	Henry Ford. No broadcast.	Northville,	Mich....		L-39
KDKA	Westinghouse Elec. Co. 10-10.15, 12.30-1.00, 2.00-2.20, 4.00-4.20 P. M., music. 7.30-7.45 P. M., bedtime story. 7.45 P. M., news. 8.30-9.00 P. M., music. 9.00-9.05 P. M., United Press Service News. 9.05-9.30 P. M., music. 9.55-10.00 P. M., time signals. Sunday 11.00 A. M., 3.00 P. M., 7.30 P. M., chapel services. Range, 2000 miles.	Pittsburgh,	Pa..	360	N-42
KDLY	Sugarland Industries. No broadcast.	Sugarland,	Texas..		AB-29
KDLZ	Sugarland Industries. No broadcast.	Galveston,	Texas....		AB-29
KDN	Leo J. Meyberg Co. Daily, except Sunday, 11.00-12.00 A. M., 1.00-2.00 P. M. 4.30-5.30 P. M., concert. 7.00-7.15, weather. 8.30-9.00, concert. Saturday, stops after 5.30 P. M. Sunday, 10.00-11.00 A. M., sacred music. Pacific time.	San Francisco,	Calif..	360-485	0-3
KDPJ	Detroit Edison Co. No broadcast.	Port Huron,	Mich...		K-40
KDPT	Southern Electrical Co. News bulletins, weather reports, lectures, sermons and musical concerts daily from 7.30-9.00 P. M. Maximum distance heard, 1500 miles.	San Diego,	Calif.	360	V-7
KDEN	Henry Ford. No broadcast.	Dearborn,	Mich.		L-39
KDPH	Detroit Edison Co. No broadcast.	Detroit,	Mich		L-39
KDPI	Detroit Edison Co No broadcast.	Superior,	Mich		
KDPM	Westinghouse Elec. & Mfg. Co. No broadcast.	Cleveland,	Ohio.		L-41
KDPV	Southern Cal. Edison Co. No broadcast.	Camp 60,	Calif		
KDPW	Southern Cal. Edison Co. No broadcast.	Camp 61,	Calif..		
KDOW	Ship. S. S. America. Ship operates with Deal Beach station of the American Tel. & Tel. Co. on tests for ship to shore phone transmission				
KDYL	Telegram Pub. Co.	Salt Lake City,	Utah	360	M-13
KDYM	Savoy Theatre.	San Diego,	Calif.	360	V-7
KDYN	Great Western Radio Corp.	Redwood City,	Calif.	360	O-3
KDYO	Carlson & Simpson.	San Diego,	Calif.	360	V-7
KDYQ	Oregon Inst. of Technology.	Portland,	Ore.	485	E-5
KDYR	Pasadena Star News Pub Co.	Pasadena,	Calif.	360	S-6
KDYS	The Tribune. Wednesday, 8.00-10.00 P. M., bedtime story, concert. Sunday, 4.00 P. M., church service. Mountain time.	Great Falls,	Mont.	360	D-14
KDYU	Herald Pub. Co.	Klamath Falls,	Ore..	360	J-5
KDYV	Cope & Cornwell.	Salt Lake City,	Utah	360	M-13
KDYW	Smith, Hughes & Co.	Phœnix,	Ariz	360	V-12
KDYX	Star Bulletin.	Honolulu,	Hawaii.	360	
KDYY	Rocky Mountain Radio Corp.	Denver,	Col.	360	O-20
KDZA	Arizona Daily Star.	Tucson,	Ariz.	360	W-13
KDZB	Frank E. Siefert.	Bakersfield,	Calif.	360	R-6
KDZD	W. R. Mitchell.	Los Angeles,	Calif.	360	T-6
KDZE	The Rhodes Co. Daily concerts, except Sunday, 3.30-4.15 P. M. Monday, Wednesday and Friday, 7.15-8.15 P. M. Pacific time.	Seattle,	Wash.	360	C-6
KDZF	Automobile Club of Sou. Cal.	Los Angeles,	Calif.	360	T-6
KDZG	Cyrus Peirce & Co.	San Francisco,	Calif..	360	O-3
KDZH	Fresno Evening Herald.	Fresno,	Calif.	360	P-5
KDZI	Electric Supply Co.	Wenatchee,	Wash.	360	C-8
KDZJ	Excelsior Radio Co.	Eugene,	Ore.	360	F-4
KDZK	Nevada Machinery & Elec. Co.	Reno,	Nev..	360	N-6
KDZL	Rocky Mountain Radio Corp.	Ogden,	Utah.	360	M-14
KDZM	E. A. Hollingworth.	Centralia,	Wash...	360	D-6
KDZP	Newberry Electric Corp.	Los Angeles,	Calif..	360	T-6
KDZQ	Motor Generator Co.	Denver,	Col..	360	O-20
KDZR	Bellingham Pub. Co.	Bellingham,	Wash.	360	B-6
KFC	Northern Radio & Elec. Co. Operating in conjunction with Seattle Post-Intelligencer. News, market reports, music, weather, etc., 9 hours daily. Heard by ships 3600 miles at sea.	Seattle,	Wash.		C-6
KFI	Earl C. Anthony. News and road bulletins, also high class entertainments from the leading theatres. Has been heard in all parts of the United States.	Los Angeles,	Calif....	360-510	T-6
KFL	Garrison Babcock. Consulting Engineer for Puget Sound Telephone Co., operating in conjunction with station of the Puget Sound Telephone Co. at Everett Wash. Used primarily as an emergency communication for company business; secondarily as a relay broadcasting station between Seattle and Everett.	Everett,	Wash.	340	
KFU	The Precision Shop. Station owned by D. M. Spencer. 5, 5-watt tubes, 2 as oscillators, 2 as modulators, and 1 as the speech amplifier, radiate 1.8 amperes on 450 volts and 2.2 on 550 volts. Program Monday and Thursday 8.00-9.00 P. M., Sunday 3.00-4.00 and 8.00-9.00 P. M.	Gridley,	Calif.	360	M-4
KFV	Foster Bradbury Radio Store. Broadcast two concerts daily, including both vocal and instrumental music. Also market reports and weather forecast. 2 50-watt tubes used, one as an oscillator and one as a modulator. Radiation 3 amperes using ground. 5.2 amperes when using counterpoise. Heard at Berkeley, Calif.	Yakima,	Wash.	360	D-7

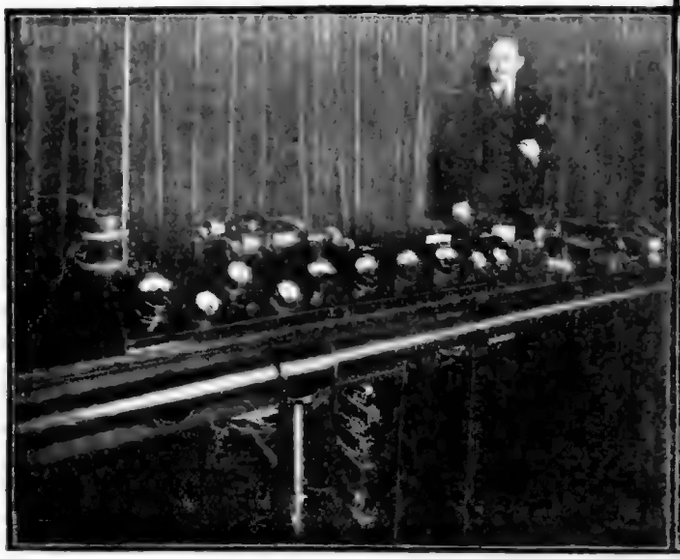
Call Letter	Name	City	State	Wave Length	Map Location
KFW	First Presbyterian Church. Two services, including sermon every Sunday. Maximum distance heard, 3000 miles.	Seattle,	Wash	460	C-6
KFZ	Doerr-Mitchell Electric Co. Limited broadcasting of music and sermons and various forms of entertainment by request. 2 5-watt power tubes are used for transmission and a range of about 100 miles in day time and 300 miles at night is obtained. Have been heard 520 miles under freak conditions.	Spokane,	Wash	360	C-10
KGB	Tacoma Daily Ledger. Operated by Wm. A. Mullins Electric Co. Music, news bulletins, baseball scores and market reports daily from 4.00-5.00 P. M., and Sundays 3.00-5.00 P. M. Musical selections daily from 7.30-9.30 P. M.	Tacoma,	Wash	360	C-6
KGC	Electric Lighting Supply Co. Concerts Tuesdays and Thursdays, 7.30-8.00 P. M. Power, 10 watts.	Hollywood,	Calif.	360	S-5
KGF	Pomona Fixture & Wiring Co. Music and news for entertainment purposes, Thursday 7.30-8.15 P. M. Mountain time.	Pomona,	Calif	360	T-7
KGG(7XI)	Hallock & Watson. News reports, orchestra and phonographic music, U. S. Public Health Service Medical Bulletin, radio questions answered, baseball scores and market reports daily. Using 2 5-watt power tubes. a reliable night range of 500 miles is obtained. Sunday 4.30-6.00 P. M. Pacific time.	Portland,	Ore.	360	T-7
KGN	Northwestern Radio Mfg. Co. Tuesday and Friday 8.45 P. M., bulletin of the Public Health Service. Northwest Industrial News. Monday, Friday and Sunday, 9.00-10.00 P. M., concert.	Portland,	Ore.	360	T-7
KGO	Altadena Radio Lab. Daily, 1.00-2.00 P. M. and 6.00-7.00 P. M. Pacific time. Consistent range, 300 miles.	Altadena,	Calif	360	T-6
KGU	Marion A. Mulroney	Honolulu,	Hawaii.	360	
KGW	Oregonian Pub. Co. Music, talks, news bulletins daily 3.30-4.30 P. M. Monday 7.30-8.30 P. M., Wednesday 8.00-10.00 P. M., Friday, 8.00-9.00 P. M., concerts. Maximum distance heard, 900 miles.	Portland,	Ore.	360	T-7
KGY	St. Martins College. Broadcast concerts and news reports Sundays, Tuesdays and Fridays from 8.30-9.30 P. M. Reliable range, 400 miles. 2 5-watt power tubes used for transmission, radiation 1.2 amperes.	Lacey,	Wash	360	C-6
KHD	C. F. Aldrich Marble & Granite Co. Concerts, lectures, etc., daily on 200 meters. Weather reports on 485. Has been heard as far east as Indiana and as far west as Catalina Island.	Colorado Springs,	Col.	200-485	P-20
KHJ	C. R. Kierulff. Operating for Los Angeles "Times." News, sport returns and financial reports as well as special musical and entertainment features. Daily, except Saturday and Sunday 1.00-1.45 and 7.15-8.00 P. M. Consistent range 50 miles.	Los Angeles,	Calif.	360	T-6
KHQ	Louis Wasmer	Seattle,	Wash	360	C-6
KJC	Standard Radio Co. Daily, except Sundays, 11.30-12.00 M. Monday, 10.00-11.00 A. M. Wednesday, 9.00-10.00 A. M. Sunday, 1.00-2.00 and 5.00-6.00 P. M., general program. Pacific time.	Los Angeles,	Calif.	360	T-6
KJJ	The Radio Shop. Tuesday, 8.15-9.00 P. M., Friday, 7.30-8.15 P. M., concerts. Pacific time.	Sunnyvale,	Calif.	360	O-3
KJQ	C. O. Gould. Daily, except Sunday, 5.00-5.30 P. M., news and music. 7.00-8.00 P. M. Wednesday and Sunday evening music. 10.00-11.00 A. M., Sunday Church services.	Stockton,	Calif.	360	O-4
KJR	Vincent I. Kraft. Operating for Northwest Radio Service Co. Daily, except Sunday, 8.00-9.00 P. M., general news and concert. Maximum distance heard, 1500 miles. Pacific time.	Seattle,	Wash.	360-485	C-6
KJS	Bible Institute.	Los Angeles,	Calif.	360	T-6
KLB	J. J. Dunn & Co. Monday and Friday, 7.30-8.15 P. M., music. Sunday, 3.00-4.00 P. M. and 8.00-9.00 P. M., music. Power to be increased ten times two weeks from present entry. Professional talent at least once a week. 600 miles.	Pasadena,	Calif.	360	S-6
KLN	Noggle Elec. Works. Daily, 12.00-1.00 P. M., news, markets and weather. 7.00-8.00 P. M. concerts. Pacific time. 150 miles.	Monterey,	Calif.	360	P-3
KLP& 6 XAC	Colin B. Kennedy Co. Monday evenings, 7.30-8.30. digest of week's industrial and electrical development followed by concert. Thursday, 8.30-9.00 P. M., musical concerts. Sunday afternoon, 4.00-5.00. concerts. Station heard 1500 miles.	Los Altos,	Calif.	360	O-3
KLS	Warner Bros. Daily 12.00-1.00 P. M., concert. Saturday, 7.30-8.15 P. M., concert. Pacific time. 2 50-watt power tubes used for transmission. Maximum distance heard, 800 miles.	Oakland,	Calif.	360	O-3
KLX	Tribune Pub. Co. Power used, 250 watts. Entertainment and press matters. No definite schedule yet.	Oakland,	Calif.	360	O-3
KLZ	Reynolds Radio Co., Inc. Daily weather 8.30 A. M. Weather and news 7.45 P. M. Concert 8.00-9.30. Sunday, 8.00-9.30 P. M., church services. Maximum distance heard, 1500 miles.	Denver,	Col.	360	O-20
KMC	Lindsay Weatherhill & Co. Monday, Wednesday and Friday, 8.30-9.00 P.M., concert. Consistent range, 100 miles.	Reedley,	Calif.	360	T-6
KMJ	San Joaquin Light & Power Co. Broadcasts entertainment three hours per week on Tuesday and Friday, 7.00-8.00 P. M., and on Sunday, 5.00-6.00 P. M. Program of phonographic music and vocalists. Station is to be employed for emergency dispatching. Consistent range, 150 miles. Maximum range, 850 miles.	Fresno,	Calif.	360	P-5
KMO	Love Electric Co. Broadcasts for Tacoma Times. Daily, except Sunday. 11.00 A. M. to 1.00 P. M. 6.00-7.00 P. M., 9.15-10.00 P. M., concerts, news, lectures. Pacific time.	Tacoma,	Wash.	360	C-6
KNI	F. W. Smith	Eureka,	Calif.	360	K-3
KNJ	Roswell Public Service Co. Daily 7.00-9.00 P. M., programs of music. Sundays sermon at 8.00 P. M. 4 5-watt power tubes used. Consistent range 300 miles. Mountain time.	Roswell,	N. Mex.	360-485	V-19
KNN	Bullock's. Broadcasts three hours each week, Tuesday, Wednesday and Thursday, from 10.00 A. M. to 11.00 A. M. Musical programs and educational lectures. Pacific time. 100 miles.	Los Angeles,	Calif.	360	T-6
KNR	Beacon Light Co. Vocal and instrumental music by professionals only. No phonographic music.	Los Angeles,	Calif.	360	T-6
KNT	North Coast Products Co. Daily 5.00-5.30 P. M. and 7.30-8.15 P. M. news, concerts. Pacific time. Consistent range 400 miles.	Aberdeen,	Wash.	360	C-5
KNV	Radio Supply Co.	Los Angeles,	Calif.	360	T-6
KNX	Elec. Lighting Supply Co.	Los Angeles,	Calif.	360	T-6
KOA	Y. M. C. A. Daily time signals and weather forecast at 9.55 P. M. Also press news. Has been heard 1500 miles. Consistent range 485 miles. Former call letters 9YAL.	Denver,	Col.	360-485	O-20
KOB	N. M. College of Agriculture. Monday and Friday nights 8.00-9.00 musical selections, with a 10-watt transmitter. Weather bureau reports at 12 noon each day.	State College,	N. Mex.	360-485	
KOE	Spokane Chronicle.	Spokane,	Wash.	360	C-10
KOG	Western Radio Elec. Co. Every afternoon except Sunday, 12.15-12.30 market reports, 5.00-5.45 press notices. Tuesday and Wednesday evening, 8.00-9.00 music. Friday evening. 8.15-9.00, music. Consistent range 300 miles.	Los Angeles,	Calif	360	T-6
KOJ	University of Nevada.	Reno,	Nev	360	N-6

(To be continued in the next issue—Save these, as they will not be repeated)



Above and to the Left are Three Pictos of the General Electric Company's Broadcasting Station, Located at Schenectady, N. Y., Call Letters "WGY." The Radio Transmitting Apparatus and the Room in Which the Artists Perform are Not Located in the Same Building, but are About Three-Fifths of a Mile From Each Other. It is, Therefore, Possible to Broadcast Music From Any Point Which Can be Connected to the Studio by a Telephone Line. The Antenna is 250 Feet Long, and Supported by Two Steel Towers 250 Feet High. There is a Counterpoise a Few Feet Above the Roof. One Hundred and Ten Volts A.C. is Used For the Power Supply, Which is Rectified Tara Kenotron Vacuum Tubes. A Filter Circuit to Eliminate the A. C. Hum is Also Employed. The Only Apparatus in the Room Where the Artists Perform are the Mircophones. A Censor Who Listens in on the Concert is in Communication With the Transmitting Equipment at All Times.

At Right:—The Broadcasting Station of the "Buffalo Courier" Located at Buffalo, N. Y., Call Letters "WGR." The General Arrangement of This Station is Unusual. An Entire Floor of the Plant is Devoted to Its Use. The Transmitting Studio, Containing the Musical Instruments, is Draped With Heavy Velvet, and a Reception Room is Also Provided for the Artists, Lavishly Furnished With Easy Chairs and Divans. A Receiving Room Adjoins the Transmitting Room, Where Four Sets are in Constant Operation. The Apparatus Was Designed by C. F. Hoole. A Cage Type Antenna Consisting of Six Wires Each 120 Feet Long, is Supported by Two Steel Masts 40 Feet High, on Top of the Building, Making the Antenna 80 Feet High All Told. The Lead-in Likewise is a Cage. Copper Tubing is Used Within the Building, and a Ground Was Formed by Burying Copper Plates in the Soil. Current to the Transmitter is Supplied by a Generator at a Pressure of 2,000 Volts.



Radio Oracle

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25¢ is made for all questions where a personal answer is desired.

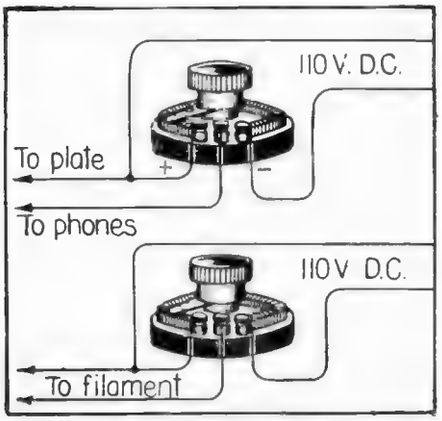
Using 110 V. D. C. on an Audion

(36) Joseph Mastrowitch, Perth Amboy, N. J. wants to know:

Q. 1. How to use 110 volts D.C., from ship emergency radio storage battery for the filament and plate potentials on his vacuum tubes.

A. 1. Wind two rheostats, each capable of carrying 1½ amperes, to a resistance of 75 ohms each, and connect them as shown in the accompanying diagram.

When you first turn on the current, be sure that the arm of the rheostat is at the end of the winding from which the lead to the set is taken. From this point start your adjustment, using great care not to apply too much current.



Methods of Using Potentiometer for Regulating Potential From 110 Volt Storage Battery to Feed Audion Plate and Filament Circuits.

Our Second Prize

(37) John Brennan, Lowell, Mass., inquires:

Q. 1. As to whether or not he would be able to receive Medford Hillside, using a set similar to the one awarded second prize in our Simplest Radio Outfit Contest, with a No. 19 wire 75 feet long and 35 feet high for an aerial.

A. 1. We see no reason why you should not be able to hear Medford Hillside with the set you mention. We would suggest however, that you use No. 14 wire in your aerial instead of No. 19. The latter is too light to stand the strain of a heavy wind or snow storm.

Interference Preventer

(38) Ralph Davis, Brooklyn, N. Y., wants to know:

Q. 1. How he can prevent all interference from spark stations while receiving radiophone.

A. 1. It is usually impossible to eliminate all code stations while listening to radiophone broadcasting stations, although sharp tuning will help considerably. Vacuum tube outfits designed for use with loop antennæ are advisable.

Q. 2. How can I load a vario-coupler to tune to WVP on 1450 meters?

A. 2. Two loading coils, each 8 inches long by 4½ inches in diameter, wound with No. 24 S. S. C. wire, and tapped or equipped with a slider, will be necessary to receive WVP. One of these coils is connected in the primary circuit, and the other in the secondary circuit. They may be inductively coupled or placed at right angles to each other or one of them rotably mounted with respect to the other.

Q. 3. Can the time signals from Arlington be received with a crystal detector?

A. 3. It is entirely possible to receive Arlington time signals with a crystal detector, but it is not necessary to tune to the wave length of this station, because WJZ relays the time signals, and it is possible for you to receive the signals on the latter's wave length, namely, 360 meters.

Receiving 1,500 Miles

(39) Emil Beguhn, Chicago, Ill., asks:

Q. 1. What are the parts necessary for setting up a radio receiving set with a range of about 1500 miles?

A. 1. In order to install and operate a radiophone receiving set with a range of at least 1500 miles, persons must be well versed in the theory and operation of radio apparatus. Such a set as this was fully described in the June issue of SCIENCE & INVENTION in the article by Arthur H. Lynch. The set we refer to was illustrated in Fig. 2. We believe however, that you would probably be better off in the end if you start with a simple set such as a crystal or single tube set. From this you can work up gradually, adding more apparatus from time to time as you become familiar with the working of the same.

Q. 2. Is one storage battery and "B" battery sufficient for such a set?

A. 2. One storage battery would be sufficient to work the set first mentioned, if it had a capacity of at least 100 ampere-hours. A separate "B" battery, however, is preferable for the amplifiers, and detector, but is not absolutely necessary.

Crystal Detectors

(40) K. J. Doyle, Victoria, Australia, asks:

Q. 1. Which would be best to use: a galena detector with a 500 ohm receiver, or a silicon detector with a 1,000 ohm receiver

A. 1. We would advise you to use a galena detector, employing a fine phosphor bronze wire in very light contact with it, and use in connection with it a 1,000 ohm phone, in order to obtain the best results. Silicon, however, if used with a brass point in quite heavy contact with it, will be found to be sensitive and very stable, beside having the advantage of not being affected by outside influences, such as vibration, to the same extent as galena.

Theory of Crystal and Audion Detectors

(41) Geo. Garrison of San Francisco, Cal., asks:

Q. 1. Explain the theory of crystal detector.

A. 1. The correct name for a crystal detector should be *Crystal Rectifier*. The reason for this is that certain crystals or minerals have the property of rectifying oscillating or alternating currents, such as that received by the antenna, into pulsating direct current, which acts on the telephone receivers. This pulsating current causes the receiver diaphragm to be alternately attracted and released rapidly, thereby creating the familiar buzzing sound or speech which are audible in the receiver. The rectifying property of the crystal is often as high as 400 to 1, that is, negative or positive impulses, as may be the case, will pass through the crystal 400 times easier in one direction than in the other, thereby producing the effect above mentioned.

Q. 2. Give the theory of the audion detector, briefly.

A. 2. The audion bulb consists of an evacuated glass tube in which is sealed a filament, which may be heated to incandescence by a low voltage battery, also, a grid or screen of wire in either a spiral form, or criss-crossed on a frame, and a flat or curved sheet of aluminum known as the plate. The positive side of a high voltage battery of 20 to 60 volts, or higher in power tubes and amplifiers, is connected to the plate, thereby impressing a positive potential thereon.

When the filament is heated it throws off negative electrons, which, since the plate is positively charged, are attracted to it. The grid which lies directly in the path of these electrons is connected to the source of incoming oscillations, through a grid condenser.

The incoming oscillations, charge the grid condenser negatively. This charge passes on to the grid and provides it with a negative potential. Now since the stream of electrons flowing from the filament is negative, it will be slightly retarded by the grid because of the old electrical law, which states that "like charges repel each other, and unlike charges attract." The variation in the grid potential, will therefore, cause a like change in the plate potential because of the fact that the stream of electrons from the filament form a path for the plate current to pass over from the plate to the filament. This change in the plate potential will cause a corresponding drop in the amount of current flowing through the receivers, and cause an audible sound therein.

The telephone diaphragm cannot vibrate at radio frequency, but the high inductance of its coil, together with the magnetic lag, smooths out the plate current vibration into an audio frequency current, which acts electro-magnetically on the diaphragm of the telephone receiver.

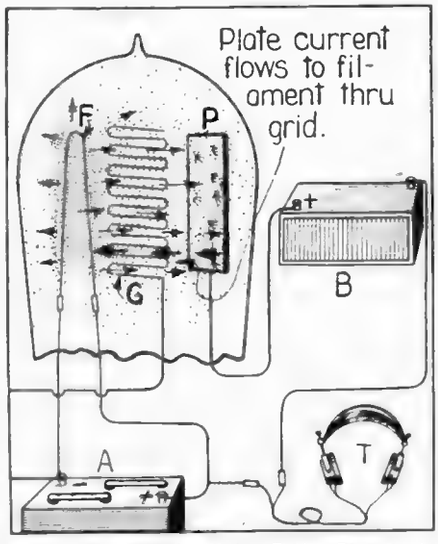


Diagram Showing the Action Taking Place in An Audion Bulb—Note That B Battery Current Flows From the Plate to the Phones T, But That the Electron Flow is From the Hot Filament F, Toward the Cold Plate P. The Varying Charges Impressed on the Grid G, Regulate the Amount of Current Passing Through the Telephone Circuit.

Unique Two-Slide Tuner Circuit

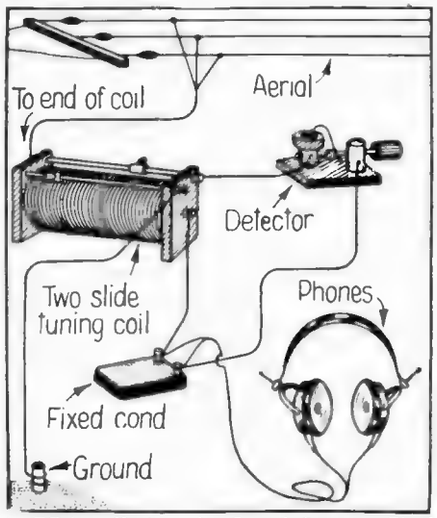
(42) Thos. J. Carney, Rigby, Idaho, requests:

Q. 1. Hook-up for a two slide tuner, using both ends of the wire.

A. 1. The hook-up is given herewith.

Q. 2. How could this set be improved?

A. 2. To increase the efficiency of your crystal receiving set, we would advise you to use two variable condensers, one across the primary, and the other across the secondary.



An Efficient Hook-up for Crystal Detector, Fixed Condenser and Phones, Together With Two Slide Tuning Coil.

Capacity Effect

(43) Frank K. Kennedy, Toms River, N. J., asks:

Q. 1. Why do I have trouble in tuning in C. W. stations using three honeycomb coils for tuning? As soon as I bring my hand near the coils, the signals start to change in pitch and intensity.

A. 1. The reason that the tones of arc stations change when you start to adjust your coils and condensers is because of the capacity effect produced by bringing the hand in proximity to the circuits. This may be eliminated by the use of a long wooden rod, one end of which is fastened to the knob of a coil or condenser, and by means of which you may rotate the knob without bringing the hand near enough to the instrument to affect it.

Lightning

(44) Jos. B. Lombardo, Phillipsburg, N. J., asks:

Q. 1. What are the dangers connected with a radio receiving set?

A. 1. The only danger connected with a radio receiving set is from lightning.

Q. 2. Would fuses in the aerial and ground leads do any good?

A. 2. To use fuses as you suggest, would not do any good. You should use either a regular lightning switch to connect your aerial direct to the ground when not in use, or else one of the lightning arresters that are on the market today, built especially for radio use.

Transmission with Telephone Transmitter

(45) Sherman G. Bassler, Zelienople, Pa., asks:

Q. 1. If an ordinary telephone transmitter could be used for radiophone transmission?

A. 1. An ordinary telephone transmitter may be used with an experimental transmitting station, providing you do not use too high a current. However we believe that you would get much better results if you use a microphone designed especially for this purpose. These may be purchased from any high-class radio supply house dealing in transmitting apparatus.

Heavy Static

(46) Jos. H. Jacobs, Paxton, Mont., says:

Q. 1. That static is so bad that he is able to distinguish signals only about two nights out of ten. How can this be reduced?

A. 1. It is extremely unusual that static should be so bad that you are unable to distinguish signals oftener than one or two nights in ten. We would say that it is impossible to overcome static entirely, but it can be reduced to a very great extent by the use of a loop antenna. Buried loops and underground antennæ (Rogers system) are particularly adapted for work in excessive static locations. Circuits for this work have been published time and again in various past issues of SCIENCE & INVENTION and RADIO NEWS.

LATEST PATENTS

Ship Salvaging Apparatus

(No. 1,412,202 issued to James M. Adams)

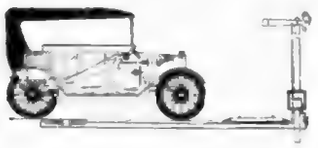
In this department a few months ago the salvaging apparatus of James M. Adams was described. This patent is an addition to the other system.

Arrowlike floats arranged all about the ship, and attached by thinner cables to floats, which rise to the surface of the water when the ship sinks, serve as the connecting links between the chains of the salvaging vessel and the vessel to be salvaged. In lifting a vessel from the bottom of the water, it is preferable to keep it raised merely clear of that bottom, whereupon it can be towed to a suitable salvaging station or to a floating drydock. In order to raise the bow of the vessel slightly above the stern, a connecting clamp housing two motors and propellers with a suitable source of current supply is employed. The inventor believes that by this means the raising of the vessel is more positive and rendered easier.

Safety Auto Control

(No. 1,418,601 issued to Alfred Minnick)

Instead of gates for railroad crossings, the inventor of the device here



shown employs a magnetic pick-up system for automobiles. An induction coil is buried in the roadbed of a road, current to the same being permitted to flow whenever a train is approaching. An iron core surrounded by a coil is supported by the automobile, so that when the auto travels over the road-coil current will be induced therein. This current serves to actuate a relay which opens the ignition circuit, and applies an electric brake to the rear wheels, or may be arranged so as to give a warning to the driver.

Power Boat

(No. 1,412,848 issued to Leonid A. Dunajeff)

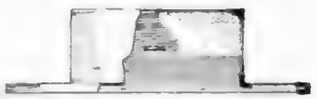
In order to overcome water resistance, the inventor of this system has

employed a means of forcing air into a space between the hull of a vessel and the water on which it floats. His device is applicable to any form of power boat, and either air-propellers or compressed air is used to drive the boat forward. At low speeds it is necessary to force this air under the boat through blowers; at high speeds, the forward motion of the boat takes care of that. If the compressed air is used for propulsion, it will be found that the blowers produce a partial vacuum in front of the ship, and a quantity of compressed air is forced out at the rear of the vessel, the propelling force being due to both. Frictional resistances are reduced, inasmuch as the boat is separated from the surface of the water. The vessel may be equipped with side planes so as to inclose the column of air, and prevent it from escaping at the sides. The stern of the vessel is provided with an adjustable extension plate with side ribs or walls.

Waterproof Covering for Hats

(No. 1,418,354 issued to Augusta Barnett and Milton I. Steinberg)

This device consists essentially of three rather heavy molded sections of rubber; one of them is U-shaped in cross section to receive the brim of the hat; another is L-shaped, which fits between the brim and the crown; and the third is again L-shaped, fitting

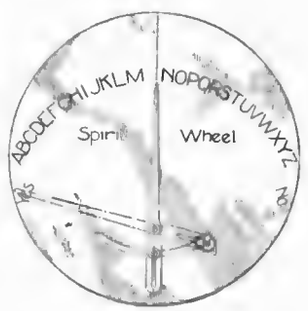


around the top of the crown. They are connected together preferably by thin rubber material. The heavier rubber reenforcements cause the covering to conform with the shape of the hat.

Spirit Wheel

(No. 1,418,686 issued to William H. Swallow)

The spirit wheel upon which the alphabet is arranged is free to rotate on a small table standing on four legs. This wheel is provided with an aperture of curved form, and a post for holding an indicating arm. The post is secured to the wheel itself, whereas the loosely fitting screw passes through this and is secured to the base. It will, therefore, be seen that the wheel is capable of being moved involun-

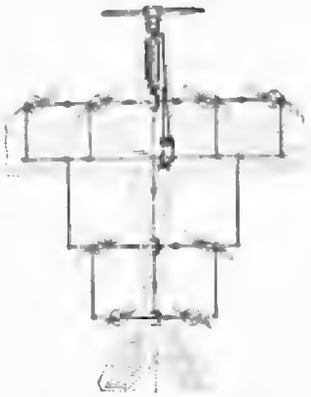


tarily by the operator, and as it moves it tends to move the pointer along with it, causing the various alphabetical indications, which when assembled will form sentences.

Airplane

(No. 1,414,314 issued to Nick G. Star)

In this device the pitch of the propeller blades is not only adjusted to suit the condition of the air, or to act as a brake by reversing the action of the propeller without changing the direction in which the motor or shaft rotates the propellers, but may also be turned from a horizontal to a vertical position, or vice versa, manually. As will be seen, the propeller blades are arranged in pairs on either side of the fuselage driven by gears. The frames for holding the propellers are

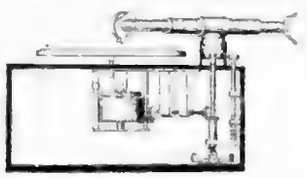


connected to the body of the plane in swinging supports. It will be seen that the plane can be changed from helicopter type to the ordinary type by simply swinging the propellers from the horizontal to the vertical position.

Phonograph Repeating Device

(No. 1,404,774 issued to Lucian Jakubowsky)

Inventions of this type seldom find a market because they are usually rather elaborate, although the construction of this one is quite simple. Repeating devices, if simple enough, may meet with greater favor. When the reproducing arm has reached the center of the record, the plate upon which the two reproducers rest will have rotated sufficiently to clear the rollers. Here the force of a spring causes the plate and rod to rise, thus

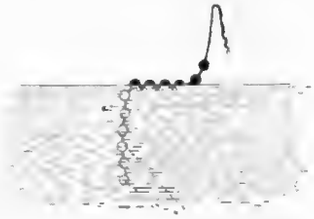


bringing gears into relation with each other, and turning the swinging arm, so that one sound box will swing away from the record, and the other sound box will swing towards the record. This being accomplished, the second reproducer is permitted to engage with the record. The lifting and lowering of the reproducers is adjustable.

Hydrometer

(No. 1,412,884 issued to Thomas Midgley, Jr.)

This hydrometer is extremely novel and clever. A number of beads are mounted upon a flexible cord. Each bead is made of different density, and all of them so regulated that no one bead itself will indicate that density, but if combined will give a true reading of specific gravity. Numerals are applied to the beads, or they may be graduated in any other manner. If

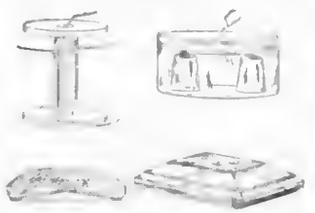


the hydrometer is, for instance, placed in gasoline, the density of the gasoline will be the number indicated on the last bead which floats.

Making Piezo-Electrical Crystals

(No. 1,414,370 issued to Alexander McLean Nicolson)

To those who have experimented with piezo-electrical crystals described in the December, 1919, issue of this journal by Mr. Nicolson himself, this method of making them will be interesting. Crystals weighing as much as one pound are very simply grown. A warm concentrated solution of sodium potassium tartrate is prepared. Into this a small warm seedling is dropped. The vessel containing the solution is then heat-insulated by wrapping with paper or placing in a fireless cooker. The crystal is preferably placed on an inverted tumbler. The crystal when removed from the mother liquor is then desiccated with a drying agent, such as calcium chloride, for two or three hours, and then submerged in alcohol, where it remains for twenty-four hours. It is then baked at a temperature of 105° F. for twelve hours. Conductors made of tinfoil sheets are then attached to the crystal and held in place by ambroid

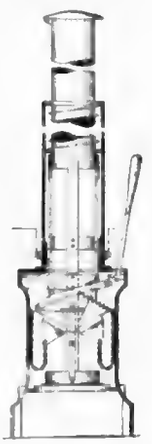


cement, with which the whole crystal is painted to exclude moisture.

Electric Wax Sealer

(No. 1,406,526 issued to Robert Boyll)

In this sealer a stick of wax is inserted into the holder and pushed down until the lower end of the stick of wax enters a trough formed by a pair of co-acting jaws. When it is desired to seal an envelope, the entire instrument is placed with its base over the package, and the tube is then



depressed. Here it is held for a short time. The downward movement causes the chains to be brought to a taut condition, which swings the electric heating elements against the inclined faces of the two jaws above referred to. The heat is thus transmitted through the comparatively thin metallic jaws to the lower end of the wax. A few seconds are required to melt a suitable quantity of wax, which flows down into the closed apex of the delivery jaws. Further downward movement of the holder accomplishes the opening of the jaws, releasing the wax, and a die is then swung into position, making an impression. The device consumes no current when it is not operating.

THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

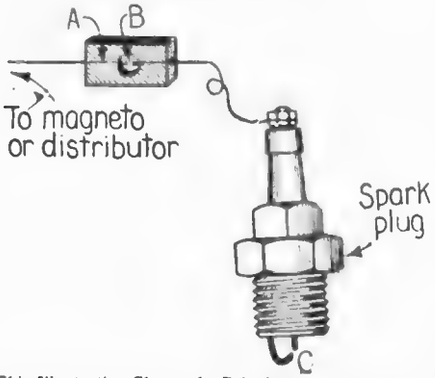
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Spark Plug Intensifier

(1260) John R. Luxton, Linton, Ind., asks:

Q. 1. What is the principle on which secondary gap intensifier for spark plug works.

A. 1. The reason that an intensifier works is because of the fact that the gap between the two points prevents the spark from passing across until the charge becomes sufficiently high to leap the gap, and this is generally at a time when the ignition is very nearly perfect. Therefore, the heat of the spark is much greater and the spark fatter. The voltage rises to a higher value than normal with two gaps, helping to fire fouled or broken plugs.



This Illustration Shows the Principle of a Spark Plug Intensifier. The Charge Collects at "A" Until the Voltage Is Sufficient to Jump the Gap "B." Therefore, a Hotter Spark Is Supposed to Be Formed At "C."

Self-Vulcanizing Rubber Cement

(1261) Antonio J. Louza, New Bedford, Mass., desires:

Q. 1. A formula for making a self-vulcanizing rubber cement, to use in repairing automobile tires and tubes.

A. 1. Here are two simple rubber cements which will answer your purpose.

Bisulphide of carbon 160 parts, gutta percha 20 parts, caoutchouc 40 parts and isinglass 10 parts. This cement is dropped into the crevices after they have been properly cleaned and the tire is bound up and permitted to dry for 24 to 36 hours. The superfluous cement is then removed with a sharp knife previously dipped in water.

For ordinary inner tubes, caoutchouc one part, and 4 parts of naptha or carbon bisulphide or 28 parts of chloroform, set aside for several days to dissolve, will answer very nicely.

Self-Luminous Lamp

(1262) Robert Juif, Torrington, Conn., asks:

Q. 1. How to make a luminous phosphorous lamp.

A. 1. A phosphorous lamp can be made by taking pure olive oil and pouring this into a small vial, after it has been heated about half an hour to a point just below boiling. In other words, the oil has been heated but not boiled. A lump of phosphorus about the size of a pea is inserted into the vial which is then tightly closed.

The lamp will be luminous for about six months, whereupon the bottle may be uncorked, and recorked, whence it again regains its luminosity for another long period.

Q. 2. What substances will burst into flame upon exposure to the atmosphere?

A. 2. White phosphorus will often burst into flame if allowed to remain exposed to the air, and sodium and potassium will do so also, provided that the air in the room is quite moist.

These substances have high affinity for oxygen. If a small piece of sodium or potassium is placed in water which had been thickened by the addition of starch, the hydrogen set free will burst into flame in the case of potassium, and sometimes in the case of sodium.

Airplanes at High Altitudes

(1263) Edward Lustig, Tuscaloosa, Ala., writes:

Q. 1. Since there are very strong winds at high altitudes, why not use them to propel airplanes, thereby saving fuel consumption, and wear and tear on the motor.

A. 1. Of course the winds that are at very high altitudes could be used for assisting airplanes to travel in one direction, but the great difficulty is attaining this altitude and after reaching it, to maintain sufficient lifting power on the part of the wings to *grip* this highly rarefied atmosphere. Even though the winds travel at a tremendous velocity, their density is very slight and, therefore, their effect will not be as pronounced as down here on earth. Here we have a pressure of 14.7 pounds per square inch at sea level, whereas at the very high altitudes this pressure may be decreased to as low as .3 pounds per square inch and, therefore, the size of the wings of an airplane would have to be proportionately increased and the pitch of the propeller likewise increased, in order to even maintain the craft at that level.

Motorcycle Engine for Propeller

(1264) Fred Jahr, Fond Du Lac, Wis., asks:

Q. 1. Can I drive a car with a chassis weighing 300 pounds by means of an airplane propeller, actuated by a motorcycle engine?

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A. 1. A 300-pound chassis is quite heavy to drive with a small gasoline engine, although it is possible that some speed will be attained after the chassis has covered sufficient ground to get well under way. The number of revolutions per minute required will depend upon the pitch of the propeller. Any manufacturer of propellers will give you the horsepower rating required, and also the revolutions which the propeller must make.

Q. 2. Would the engine have to be run so fast that it would soon be ruined?

A. 2. We doubt very much if any harm will be done to the motorcycle engine, but in order to decrease its speed, it would perhaps be advisable to use an oversize propeller.

Life in Pure Oxygen

(1265) Leslie E. Blackmar, McPhersons, Kansas, inquires:

Q. 1. If animals could live in pure oxygen.

A. 1. We doubt if animals will live for any length of time in an atmosphere of pure oxygen. Such oxygen has a deleterious effect upon the tissues in the alveoli of the lungs. We do not know of any experiments conducted along these lines, but would suggest that the experiments could easily be made. In our opinion the life of an animal would be from two to four weeks in this atmosphere of pure oxygen.

Freak Transformer

(1266) L. H. Bullard, Utica, N. Y., asks:

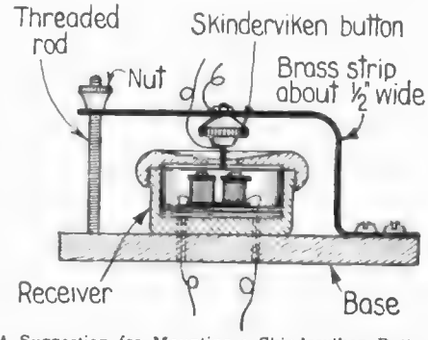
Q. 1. Give data on the construction of a transformer, the potential in the primary to be at a pressure of 110 volts and the secondary 60 amperes, at 110 volts.

A. 1. We see absolutely no sense in building a transformer such as you suggest, having a primary voltage of 110, and a secondary voltage of 110. Such a transformer, instead of giving better results, will consume about 64 amperes on the primary side, in order to deliver 60 amperes on the secondary side as you desire, but there is no economy here. Why not use the current directly?

Skinderviken Button Queries

(1267) John Bennett, Atlanta, Ga., asks:

Q. 1. Give directions for the use of a Skinderviken button.



A Suggestion for Mounting a Skinderviken Button to Be Used for Amplifying Radio Signals. By Turning the Nut the Pressure Between the Button and the Diaphragm of the Receiver May Be Varied.

A. 1. The Skinderviken button is a very small transmitter which works on the principle of varying the resistance of carbon grains when compressed and released. It may be used in any place where an ordinary transmitter would be used, and will give satisfactory results.

Q. 2. Could it be used to amplify radio signals?

A. 2. You might try using it to increase the volume of signals from a radio set by placing the machine screw, fastened to the diaphragm, in contact with the diaphragm of one of the radio receivers. This should be arranged in such a way that the amount of pressure at the point of contact may be varied to secure best results, a suggestion for which is shown in the accompanying cut. The transmitter button should then be connected to local battery and to a 4-ohm telephone receiver. If you wish higher amplification, you might try connecting the button with a local battery, and the primary of a telephone transformer; connecting the secondary of the transformer to a 75-ohm telephone receiver (higher resistance than in former case).

Lamp Filaments

(1268) Jos. H. Jacobs, Paxton, Mont., asks:

Q. 1. If the efficiency of an electric light bulb would be increased by rolling the filament out flat instead of round.

A. 1. Although we do not believe that the efficiency of the incandescent filament of an electric lamp will be increased by rolling the filament flat instead of round, the idea is not by any means new, and in a certain class of vacuum tube detectors, the filaments are flat, and then twisted spirally along their length.

Q. 2. Can an electric motor be built light enough yet powerful enough to propel an airplane? I understand that high power electric motors are very heavy.

A. 2. Of course, an electric motor can be built light enough to raise its own weight, and not only that, but also the weight of its source of power supply. Take the model airplanes in which electric motors are used as the driving agents, as practical examples.

Conducting X-Rays Via Wire

(1269) Roy M. Crabtree, Enid, Okla., asks:

Q. 1. If there is any known way by which X-rays may be transformed so that they may be conducted along a wire.

A. 1. The transforming of X-rays into electricity or other energy is impossible when one figures on

direct transforming. The effect of these rays, however, acting on electrical circuits is quite pronounced. Thus, if an audion detector is placed in the path of the X-ray in such a way that only the grid and the plate are in use, and a potential of 200 or more volts is applied to the plate, the action of the X-rays will permit surges of electrons to pass across the tube from the grid to the plate, and conduct enough current to produce an audible sound in the telephone receivers.

Q. 2. If a radio transmitter were constructed so as to send out waves with a length of one billionth of a meter, would these waves be X-rays?

A. 2. It is doubtful if a radio transmitter ever will be constructed which will radiate waves having a wave length of one billionth of a meter in length, but even such short rays could not strictly be termed X-rays, inasmuch as the vibrations per second of the two are different.

Q. 3. Do X-rays, light rays and chemical rays differ from Hertzian waves only in the frequency of vibration?

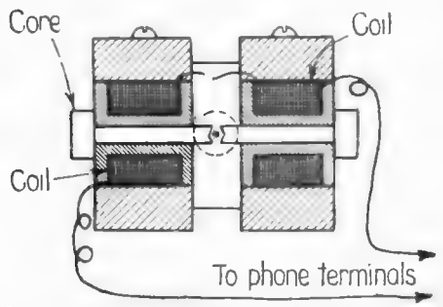
A. 3. X-rays, light rays and chemical rays differ from Hertzian rays in the frequency of vibration and perhaps also in the nature of the ray itself, although this has not yet been definitely determined. X-rays are the result of cathodic bombardment and it is thought light rays may be due, in the sun, to the bombardment of that body by smaller bodies in the universe. It is quite possible that all electrons are the same, but the instant that these vibrate at a different frequency the nature of the substance is, as has often been stated, changed. If the electrons in any body could be immediately freed, a vast store of energy and power could be accumulated from disintegrating the atoms found even in an ordinary copper penny.

Telegraphone

(1270) B. L. Kissinger, Hamilton, Ind., asks:

Q. 1. Give me information on the working of the Poulsen telegraphone.

A. 1. The Poulsen telegraphone of which you speak operates in the following manner. A long steel



This Illustration Shows How the Steel Wire In the Telegraphone Passes Between the Poles of the Magnets. The Steel Wire Is Indicated By the Dot In the Center of the Dotted Circle.

wire wound upon two bobbins slowly passes between two magnets, as shown in the accompanying sketch. The magnetization of these magnets is affected by a microphone which has a set of batteries connected in series with it and therefore, as the wire passes between these magnets, it receives a magnetic impression, dependent in strength on the changes of the current in the circuit.

These impressions are quite durable and are absolutely free from all defect and distortion except that which would result from the ordinary telephone receiver. The wire is then rewound back to the first bobbin, or spool, and passed through the space between the magnets.

This time however, instead of the microphone, a telephone receiver is placed in the circuit, and the voice is repeated back over the line. All traces of the voice are removed from the steel wire by passing direct current through wipe-off magnets likewise arranged alongside of the steel wire.

What Current Is Necessary to Kill?

(1271) Jos. B. Eckert, Sandusky, Ohio, asks:

Q. 1. Is the effect of being shocked by a live wire dependent more upon the amperage than the voltage?

A. 1. A current of 110 amperes, at a pressure of 6 volts, will have practically no effect on the operator.

If the voltage is increased and the amperage remains the same, so that the voltage rises to about 500, a severe burn will result. At this pressure, even an increase in amperage to 1000 amperes will produce like results. In rare instances it may produce death, but for that matter even 110 volts may kill.

Nine amperes at 1,500 volts is generally used in electrocutions. So you see the voltage bears no relation to the amperage. Some individuals will succumb to a potential of 110 volts, which is not sufficient to force any great amount of current through the body, whereas others require three shocks in the electric chair to kill them, although to all purposes they are dead after the current is turned off the first time. In order to make it still more clear, we would advise that certain persons have been shocked by live wires, carrying several thousand volts. Others struck by lightning are still alive to tell the tale, whereas, at times, mechanics repairing overhead trolley wires conducting current at a pressure of 550 volts have been killed. With high frequency electricity the effect is entirely different, and as much as one ampere (as in the case of Nikola Tesla), has been passed through the body at a pressure of several million volts without deleterious effects.

In high tension circuits, the results and conditions when receiving a shock vary so much that no infallible law can be stated.

Amount of Hydrogen from Water

(1272) Arthur C. Chancellor, Philadelphia, Pa., asks:

Q. 1. Please give data on the amount of hydrogen released from a certain amount of water by electrolysis.

A. 1. Usually for each 1,000 cu. ft., of hydrogen, 5.76 gallons of water are used, or in other words, 173.5 cubic fee. of hydrogen per gallon of water. The International Oxygen Company, however, claims to get 1,000 cubic feet per 4 gallons of water.

Q. 2. What is the amount of hydrogen and oxygen released by electrolysis using a certain amount of voltage and amperage?

A. 2. We also find that 7½ cu. ft. of hydrogen is released per one K. W. hour, two volts per cell being used and two and one-quarter pounds of chemically pure caustic soda is used to make the water electrically conductive, the specific gravity being 1.25 at 60° F. The current used is 600 amperes and 4.8 cu. ft., of oxygen are produced every hour at 2 volts pressure. Each cell contains two plates 3½ x 4½ inches.

Gas Engine Crank Positions

(1273) Chas. W. Hall, Monte Vista, Colo., asks:

Q. 1. Do the different positions which form between the connecting rod and the crank of a gasoline motor have any effect on the power produced? That is; is the force applied to the piston equivalent to the power produced, disregarding friction and other losses?

A. 1. The force applied to the driving wheels will always be equivalent to that applied to the piston, disregarding of course, losses due to friction and other causes. In other words, horse-power cannot be multiplied by leverage or other mechanical means. It is possible however, to change the form of the effect of power by means of gears and levers, as is readily indicated in the transmission of an automobile. In this case, the low gear develops high power with low speed, and when geared high one procures high speed with a corresponding decrease in power, although in both cases the same force on the piston of the motor is exerted.

Some Articles in July "Practical Electrics."

Automatic Train Control.
By Frank J. Sprague.

Electrogeoscopy.
By T. O'Conor Sloane, Ph. D.

A Laboratory Ultra-Violet Electric Lamp.

True Electrical Experiences (Concluded).
By H. Winfield Secor.

Thermo-Dynamic Electricity.
By F. R. Kingman.

Tesla's Electrolytic Clock. By E. Moen.

Electric Lighted Violin Bow.

Illuminated Route Card-Holder for Tourists. By Maurice E. Pelgrims.

An Alternating Current Battery.
By Raymond B. Wailes.

Cocoanut Oil Hard Soap

(1274) Edward Kehl, Philadelphia, Pa., requests:

Q. 1. A formula for hard soap containing cocoanut oil.

A. 1. Put 25 pounds of cocoanut oil, and 25 pounds of caustic soda lye of 27° Baumé into a soap kettle, boil and mix for two hours until the paste thickens, then diminish the heat, but continue stirring till the paste assumes a white, half solid mass, then transfer quickly to the frames.

Action of Mercury Vapor Lamp

(1275) Russell Holt, Minneapolis, Minn., wants to know:

Q. 1. How to construct a mercury vapor lamp.

A. 1. The construction of a mercury vapor lamp is far beyond the scope of the average experimenter, because of the fact that it requires a very high vacuum in the tube. These lamps are manufactured in different types, some of which work on A. C. and some on D. C., and also at different potentials.

Q. 2. The action of a mercury vapor lamp.

A. 2. The action is as follows: The mercury runs from one end of the tube to the other, forming a momentary circuit which starts an arc. The heat of the arc vaporizes the mercury through which vapor the current passes, giving forth the bluish-green light peculiar to this lamp. Other methods of starting the lamps are now employed.

Smoke for Stage Work

(1276) John Frager, Philadelphia, Pa., requests:

Q. 1. A method for producing smoke for stage effects without the use of chemicals. The smoke is to issue from a cauldron at certain pre-arranged intervals.

A. 1. The best method of producing smoke, if the chemical method is to be ignored, would be to employ steam.

A small steam radiator or burner can be connected up to the cauldron with the proper hose, or a Bunsen burner or alcohol flame may be placed inside the cauldron.

A by-path so arranged that the steam will be permitted to exude into the air whenever desired, will work very well. This would, of course, have to be operated by someone behind the scenes. This method is used in theaters to a very great extent.

Another method of giving an effect of smoke would be to have lycopodium powder placed in a glass or other receptacle. A rubber hose leading up to the cauldron should be inserted into the powder.

Whenever it is desired to have "smoke" exude an operator behind the scenes blows into the hose. The lycopodium powder being light and fluffy is tossed up into the air. If illuminated, the effect is very entrancing.

Repairing Broken Test Tubes

(1277) Arthur Smith, Coatesville, Pa., asks:

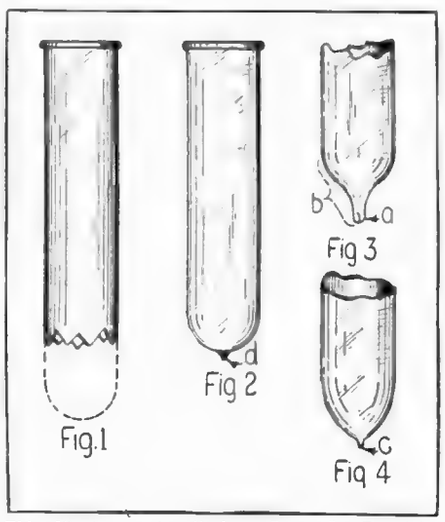
Q. 1. Give a solution for or a method of repairing test tubes, the bottoms of which are broken.

A. 1. A very good method of repairing broken test-tubes is described herewith:

The broken test-tube is lowered into the Bunsen flame and the jagged edges, when soft enough (still held in the flame) are pulled out with the aid of an ordinary pair of pliers. When the walls seem thin enough, the jagged edges are drawn together, thereby closing the end of the tube as in Fig. 2. The heat is concentrated on "b," Fig. 3, and when soft enough the tip "a" is drawn out (while held in the flame).

The result appears at Fig. 4. Still holding the tube in the flame, the bottom is heated until soft when it is quickly removed, the open end placed to the mouth, and the breath forced into it. This is done several times until the bottom assumes the shape of that at Fig. 2. Then it is annealed well in the luminous flame and set aside to cool. The result is a test-tube that may be used for all ordinary purposes not requiring heat. The tube may also be used in the flame if the tip of thick glass "d." Fig. 2, is removed with the aid of a grinding wheel or an oil-stone and the tube re-heated and annealed again.

The jaws of the pliers must be hot when they come in contact with the hot glass an preferably pliers with narrow jaws and insulated handles should be used. Before introducing the broken test-tube in the flame it must be well heated in the air above the flame to prevent further cracking.



This Illustrates the Various Steps In Repairing Broken Test Tubes.

Copying Paintings

(1278) F. W. Smith, Philadelphia, Pa., asks:

Q. 1. Is there any device on the market which will aid in copying paintings and sketches?

A. 1. We do not believe there is any device manufactured which will assist you in drawing and painting pictures, but, several could be built.

For instance, the reflection method could be employed, or else a sort of camera used. This would necessitate a large light-proof box. The picture to be copied or painted is placed in an inverted position, in one end of the box and fully illuminated. A lens is inserted in the adjacent wall of the box, and the easel upon which the artist works is moved back and forth on the other side of the lens until the object is properly focused. The painter can then copy the lines as reflected upon the canvas.

It is strange to note that very few individuals are making use of this system, although it is easy to construct, and permits the making of duplicates in actual hand painted oil colors in rapid order, faithfully duplicating the touch of the masters. Then there are the camera lucida and the pantograph methods not discussed here.

Heater from Ford Generator

(1279) H. C. Taylor, Jersey City, N. J., would like:

Q. 1. Advice on building an electric heat r to use to bring one gallon of milk to the boiling point. Said heater to be operated by a dynamo taken from a Ford car.

A. 1. We doubt very much if you could build an electric heater capable of boiling milk which is to work upon current delivered by a dynamo from a Ford car. The voltage of this dynamo is generally only about eight to twelve volts, the amperage never above ten.

The result is that the entire output of the generator is within or slightly above 100 watts, and a heater consuming 100 watts would require a very long time in order to boil the milk, perhaps 15 minutes to an hour, if at all.

A Thousand Fascinating Experiments Are Available to the Owner of

THE N-S MICROPHONE BUTTON

(Patents Pending)

$1.00 PREPAID ANYWHERE ON RECEIPT OF PRICE

Fig. 1. Showing N-S Buttons, Full Size

$1.00 PREPAID ANYWHERE ON RECEIPT OF PRICE

FIG. 5

PHONOGRAPH MUSIC AT A DISTANCE

FIG. 6

AS A DETECTOPHONE ON PICTURE

WHAT IT IS

The N-S Microphone Button is a miniature telephone transmitter. It consists of two metallic electrodes, a mica diaphragm and a quantity of carefully selected and polished carbon granules. Carbon granules possess the characteristic of changing their resistance to the flow of electricity in accordance with the degree to which they are compressed. When sound waves strike the N-S Microphone Button the varying force of the waves make proportionate changes in the resistance of its carbon granules. Consequently, when an N-S Button is connected in series with a telephone receiver and battery, the telephone receiver will reproduce any sounds, voice or music spoken near the Microphone Button. This opens up a wide field of practical usage and an interesting series of experiments for the N-S Microphone Button.

Fig. 3 shows the common form of connections. "B" is a dry battery, "R" is a telephone receiver and "S" is an ordinary single pole switch. "D" is a metal diaphragm or other thin vibrating object to which the N-S Button is attached for the purpose of better intercepting and collecting the sound waves.
Fig. 4 shows the connections when using a telephone induction coil for distance work.

Full Instructions Accompany Each N-S Button.

DEALERS

Write for Interesting Proposition on N-S Microphone Buttons and Newman-Stern Radio Apparatus

WHAT YOU CAN DO WITH IT

The Newman-Stern Microphone Button may be used as a replacement unit for worn-out telephone transmitters. It may be installed in a few minutes by following our directions.
Speech, phonograph records, music, etc., may be transmitted to a distant place by properly connecting the N-S Button.
The N-S Button will serve admirably as a detectophone by concealing it in a cigarette box or behind a picture, thus enabling anyone to hear what is being said and done.

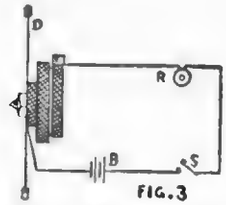


FIG. 3

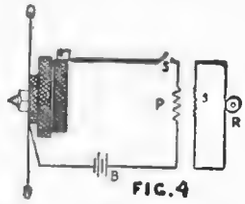


FIG. 4

For Radio Telephone Transmission

The N-S Microphone Button makes the ideal modulation microphone for radio telephone use. It will carry heavy current and is extremely sensitive. If large power tubes are being used, several **N-S Buttons** may be attached to a single diaphragm and connected in parallel, thus dividing the current and preventing packing.

Loud Speakers and Amplifiers

Many different methods are available to the users of **N-S Microphone Buttons** for amplifying radio signals. The button may be attached to the diaphragm of the telephone receiver, a local battery and 80 ohm receiver being connected in series. Various types of lever action may be experimented with. The field is most interesting and may lead to some ingenious discoveries in the line of loud speakers.
EXPERIMENTERS will find the N-S Microphone Button a source of countless experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves, etc.

WE WILL GIVE $5.00

to anyone who sends in a new suggestion for the use of the N-S Button, providing we find it suitable for use in our literature.

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Newman-Stern Bldg. Dept. 211 Cleveland, Ohio

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Write for our catalogue and bulletins describing standard lines of radio equipment including Radio Corporation, Murdock, De Forest, Amrad, Magnavox, Firth, Chelsea, etc., and the following famous Newman-Stern Products:

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Arlington Tested Crystals
Teagle Rheostats, Sockets
Condensers, Detectors, etc.

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PIN $1.00 TO THIS ORDER BLANK AND WE'LL SEND AN N-S BUTTON BY RETURN MAIL

The Newman-Stern Co.,
Cleveland, Ohio.

Enclosed find $1.00 for one Newman-Stern Microphone Button, complete with instructions.

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Street Address or P. O. .....

City and State .....

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Tell us what you are doing, what you want to be, and get our friendly counsel free. We will not paint dreams that you cannot realize, but we will tell about a whole-hearted service that in the last two years has solved the problem for many thousands of young men.

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Civil Service
Concrete Engineer
Dairy Farming
Draftsman
Electrician
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Mystic Feats of Hindoo Fakirs

By LEON GREBSNAL

(*Continued from page 333*)

in a bladder hung within the basket. In those cases in which the child is found within the basket, the performance is simpler still. The child simply squirms into such a position as will avoid the thrust of the sword.

A variation of this basket trick was performed about fifty years ago in a London theatre by the celebrated Hungarian magician, Kratki Baschik, to the bewilderment of numerous crowded audiences. The trick was introduced by the relation of a romantic story. The magician, he said, had been deeply enamored of a beautiful dancer in the ballet, but she had deceived him in favor of another man, and he was consequently resolved to wreak his vengeance upon her. She will come to a rendezvous which he has appointed, and then he will kill her. Presently she comes upon the stage, and he pretends to be reconciled to her. Then he invites her, just for fun, to see if she can stow herself within a big basket which stands on a small table in the centre of the stage. She at first objects, but presently is persuaded to get into the basket. Instantly he clasps down the lid and fastens it, and then plunges his sword through the side of the basket. Her shrieks of agony are heard, growing fainter and fainter, and at last dying away to silence. Then he opens the basket, and finds nothing but the woman's skirt. She herself has vanished. He closes the basket-lid again and indulges in a long monologue, repenting of his deed and wishing that his beautiful mistress were alive again. If she were, how he would love her! Then he again opens the basket, and lo! she is there, alive and unharmed.

The explanation of this trick differs materially from that given for the trick of the Hindoo fakirs, and it depends upon the construction of the table upon which the basket is placed. This is apparently a simple table, supported by four legs, and open underneath, so that the spectators can freely see under it. But in fact there are attached to the two hind legs two mirrors, extending forward diagonally, meeting each other in the centre. Looking into these the spectators behold the reflection of the draperies at the sides of the stage, looking exactly like those at the rear, and of course suppose that they are looking straight through under the table, while the mirrors in fact serve as a screen behind which the woman makes her escape through a trap-door in the bottom of the basket behind the table. Her cries and shrieks of pain are uttered after she has left the basket and is underneath the table.

A similar device is employed in the familiar trick in which a man is bound hand and foot, placed in a trunk which is securely locked and strapped. In a few moments the trunk is opened and is found to be empty. The performer then goes to a wardrobe or cabinet, standing on legs at the other side of the stage, unlocks and opens it, and there discloses the man who had been placed in the trunk. The secret is quite simple. There is a trap-door in the bottom of the trunk, which is placed directly above a corresponding trap in the floor of the stage. Through these the man escapes from the trunk. He walks under the stage to a similar trap at the other side, through which he ascends into the wardrobe, the floor of which is provided with a trap directly over that in the stage. His passage through the space between the stage floor and the floor of the wardrobe is not seen, because he is behind a screen of mirrors attached to the wardrobe legs, just as in the basket and table trick.

Much mystification has been caused to innumerable audiences by the performance of a "magician" who from a vase draws any number of oranges. The vase is freely passed about for examination, and is seen to be quite empty. It is placed on a small table supported by four slender legs and apparently entirely open underneath. The magician bares his arm to the shoulder, so as to avert all suspicion of concealing the oranges in his sleeve. He once more exhibits the vase, to show that it is empty. Then he places it upon the table, and immediately picks an orange out of it. Again he turns the vase upside down and displays the interior, to show that it is empty, and again picks an orange out of it. These actions are repeated, in rapid succession, *ad libitum*. The explanation is that the table is provided with mirrors, as in the tricks already described, behind which crouches a confederate, whose hand and arm are completely covered with a black glove, so as to be quite invisible against the black background of the stage. He holds an orange perfectly concealed within his black-gloved hand, reaches up and places it within the vase, which, by the way, is also lined with black. This action is thus entirely invisible to the spectators. Then the magician readily picks out of the vase the orange which his confederate has placed within it.

Another orange trick, equally mystifying, is performed without the aid of mirrors. Standing on a black-draped stage, the magician extends his hand and apparently plucks orange after orange out of the empty air, the orange not being visible until it is in his hand. The simple explanation is that a black-gloved confederate stands behind the curtain and hands up orange after orange concealed within his black-gloved hand, to become visible only the instant the performer picks it from within the black glove. The hand of the confederate is invisible against the black draperies, and the illusion is perfect of the oranges being picked out of the air.

Most formidable of all the performances of the fakirs of India is that of burying alive. In some cases there is reason to believe that there is actually suspended animation, due to the practice of what is called Pranayama, or regulation of the breath. Through this adepts are said to acquire the power of abstaining from eating and drinking and even from breathing for a long time, perhaps for months, and of becoming quite insensible to external impressions. A most competent and trustworthy observer, Dr. McGregor, has described such a performance which he witnessed at Lahore. A fakir was placed in a wooden box, the lid of which was locked, and was placed in an underground tomb. Above the tomb was a small garden house, which was also carefully locked, and around the garden was a high wall, which was constantly patrolled by armed sentries, and the only gateway through which was walled up. For forty days and nights the fakir was thus immured. Then, in the presence of the Maharajah, several of the Sirdars, and a number of British officers, the tomb was opened. First the gateway in the wall was reopened; then the garden house was unlocked; the subterranean tomb was opened, and the box was unlocked. Nowhere was there perceived the slightest trace of meddling. The fakir was found in the box, in a sitting posture, covered with a white linen sheet, and quite unconscious. Water was poured upon his head, followed with a cake of hot attar, and a plug of wax was removed from one nostril. In a short time he began to breathe again, then to speak in a low tone, and finally regained his normal vitality.

(*Continued on page 374*)

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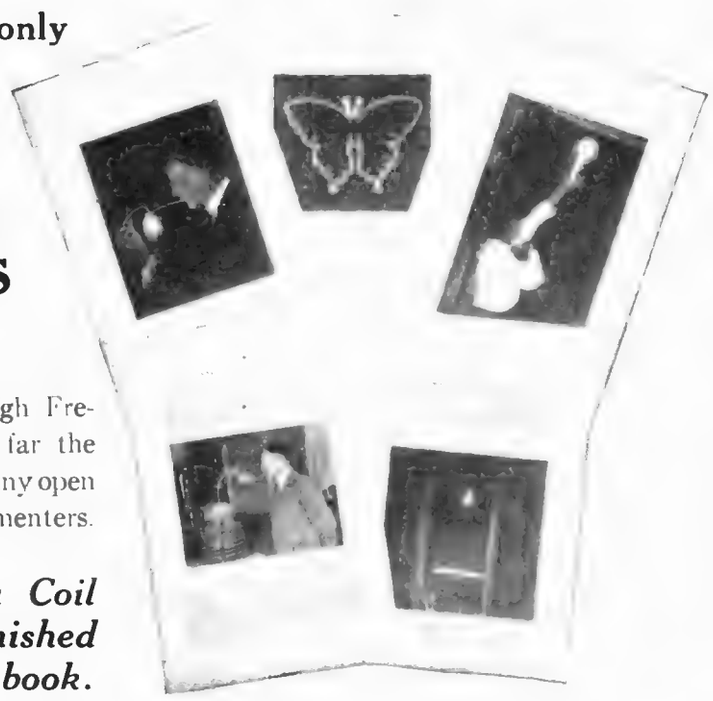

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Mystic Feats of Hindoo Fakirs

(*Continued from page 372*)

The majority of cases of burying alive are, however, sheer trickery. The man is placed, it is true, in a coffin or box, and is buried in the ground, in an open field, remote from any building or other object, and the spot is carefully watched day and night. At the time agreed upon the grave is reopened. There are no perceptible traces of any meddling with it, and the man is found within the coffin, alive and well after weeks or months of burial. The explanation is simple. A tunnel runs from the grave under the field to the edge of an adjacent grove, and there emerges within the trunk of a large hollow tree. As soon as the fakir is buried he opens the end of his coffin and crawls like a mole through the tunnel to the hollow tree. Thence he escapes and goes, perhaps, to his home, to remain in hiding until the time set for his resurrection. It is to be noted that the precise day and hour for the reopening of the grave are always agreed upon in advance, in order that he may know precisely when to return through the tunnel to his coffin. It is, of course, easy for him to feign unconsciousness, emaciation, or any other conditions which might naturally be supposed to have come upon him as a result of such a period of interment.

Another very common trick, which has been seen by almost every traveler in India and in which probably a large majority have faith as an actually supernatural achievement, or at least as one quite inexplicable to them on natural grounds, is the so-called mango trick. The mango is chosen partly because it is so familiar a fruit, as an apple might be chosen here, and partly because the exceptional readiness with which a small mango tree, when wilted and withered, responds to the application of water. The fakir exhibits to the crowd a mango seed, an empty flower-pot, and a napkin, or a shawl. He fills the pot with earth and buries the seed in it, in plain view of the spectators, then spreads the napkin or shawl over it and makes a few mysterious passes with his hands, beneath the cloth. Then he raises the cloth, and shows the onlookers a little mango tree, just bursting through the surface of the soil. He pours water upon it, with certain incantations, replaces the shawl, and makes further passes with his hands. After waiting a few minutes, he again raises the covering, and displays a little mango tree several inches high, with green leaves, apparently in healthy and robust growth.

The explanation is perfectly simple. When the fakir first makes the passes with his hands beneath the shawl, he buries in the soil in the pot the little mango tree which, wilted and shrivelled, he had concealed in the palm of his hand, leaving just the tip of it protruding from the surface. The water which he then pours upon it causes it in a few minutes to revive and straighten up, fresh and vigorous, as though it had just grown from the seed.

A number of supposed performances by fakirs, of most wonderful character, in fact never occur at all save in imagination. Many of the fakirs are adepts in the art of hypnotism, and this they apply to the spectators. When all are thoroughly hypnotized, the fakir suggests to their minds the trick he is supposed to perform, and when they are again brought out of the hypnotic spell, they firmly believe that they have witnessed some astounding deeds which really did not happen at all.

Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page 361*)

Amplification by the use of electron tubes is the standard method of getting more sound out of a radio receiver. Electron tube amplifiers may be used with crystal detectors as well as with electron tube detectors, though it is not often done. If one or more tubes are to be operated the batteries may as well supply current for a detector tube also. A single detector tube, used with a regenerative circuit, will both detect and amplify. The regenerative circuit is a patented device and cannot be used legally without a license from the corporation controlling it. The builder of the apparatus is the one who secures the license. If he complies with the law the purchaser is free to use the circuit. But a person who buys radio parts and connects them himself with a regenerative circuit is as a rule not affected by patents.

There are two general types of amplification. One method, commonly used at present, is to amplify the current from the antenna after it passes through the detector. This is called *audio-frequency amplification* because it takes place in a current which is pulsating at a rate equal to the vibrations of the air which we know as sound—somewhere between 16 and 10,000 times per second as a rule. The other method is to amplify the current before it passes through the detector. This is called *radio-frequency amplification* because the current when acted upon is oscillating at radio frequencies, maybe a million or more times per second.

Radio frequency amplification has the advantage of sending through the detector signals, voice and music, that would be too weak to get through without amplification.

The user of an amplifier does not need to know how it does its work. He simply takes the phones off his receiver and attaches the amplifier in their place. Then he attaches the phones to the amplifier at the place marked "P" or "Phone." The tube is lighted and he gets from twenty to a hundred times as much sound as he had before.

The current that proceeds from a two-stage amplifier, which is one that employs two electron tubes with the necessary auxiliary apparatus, is usually strong enough to operate a device that will throw the sound out into a room as a phonograph does. There are many trade names for these devices but the general term that includes them all is *loud talker*.

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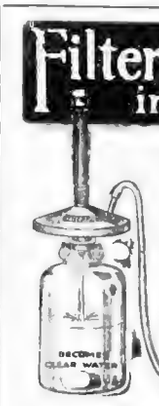

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Science Tells Musically Talented

By A. H. KOLBE

(*Continued from page 325*)

was used by the army during the war to test the hearing, and it is used in practically every important institution for ear treatment in the country.

Dr. Schoen is engaged in research work in connection with the mood chart system of analysis of the effect of music upon the mass of people. After going over 20,000 of these mood charts collected from all over the country, and making conclusions, he made a concerted test of fifteen students in the school, under rigorous experimental conditions, and proved that what was true of the thousands was true of the few. And these are some of the conclusions.

Capacity for music appreciation is inborn, inherent, and just as much a talent as music production. Music has the power to change a variety of moods and to induce similar types of moods in all persons. The degree of enjoyment found in music depends upon the musical sense of the hearer.

The mood charts were made by the notation of the listener's mood impressions before and after hearing a phonograph record. Of course, much depended upon the listener's ability to define his emotions, but it is expected that soon instruments to accurately define emotions will be employed in these tests. However, the mood charts are thought to be fairly accurate and sincere, and they have given a great insight as to the effect of music upon audiences.

Speaking of critics, the future holds many things. Picture the debut of one aspiring embryo soprano in the year of grace, 1950. The scene is in the anteroom of the opera house. Her audience numbers the critics of the leading papers and no others. In the room are all the detecting apparatus of that period to help the critics to determine her exact musical status. She begins to sing. The faithful *tonoscope* registers a *slide* of seven vibrations and she *overshoots* the note by seven vibrations before settling firmly upon it. And then she is subjected to further tests with strict tabulation of the tests. In the end there is a scientific conclusion.

But to get back to the tonoscope, this instrument has great possibilities as an accurate piano tuner. By its use tonal perfection could be attained, and by tonal perfection the doctors would be robbed of many cases of earache.

The present methods of teaching singing are woefully inefficient, Dr. Schoen believes. Correction will come by the use of the tonoscope, a small studio model of which is ready for the market.

TIME-WRITING MACHINE

A machine for writing time formed the subject of a paper read recently before the French Academy of Sciences by M. Bigourdan, Director of the International Time Bureau.

The "electric chronograph," as it is termed, consists of apparatus packed in a box less than a foot square, easily transportable, whereas previous instruments of the same character have been unwieldy and only employed in astronomical installations. On pressing a button, the machine records in script the exact chronometric instant in hours, minutes, seconds and hundredths of a second.

M. Bigourdan emphasized the need of explorers and others for the automatic recording, but there is a more immediate and practical use in the realm of sport, where the start and finish of any race can be automatically timed. The police may also find it a useful ally in convicting speeders over measured distances.

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Seaplaning from Florida in Record Time

(*Continued from page* 341)

An automobile would make the run in thirty hours, if it traveled at an average speed of forty miles per hour.

The steamships on the coastwise service make the trip between the northern and southern cities in seventy-two hours, or at an average of 16½ land miles per hour. Compare this with the lightning-like speed of the man-made *bird of the air,* as it flew northward recently, tearing thru the air at the rate of 121 miles per hour.

Clifford L. Webster, who, with Fred R. Golder, piloted the *flying yacht,* said that had he not been handicapped by the elements, he could have bettered his time considerably. So dense was the fog at times that he was compelled to steer his course by compass. The plane left Palm Beach at 5:48 o'clock in the morning and arrived at the airport in front of the Columbia Yacht Club, Eighty-second Street and North River, New York City, at 5:04 in the afternoon. One stop was made at Southport, N. C., at 11:11, the fliers resuming their northward journey at 12:31 p.m.

Grover Loening, designer and builder of the craft, found the plane almost as fast as the telephone and taxi service. When the plane flew over Atlantic City his representative there put in a call to Mr. Loening at the latter's office, Thirty-first Street and East River, New York City. By the time Mr. Loening received the call and went by taxi to Eighty-second Street, the plane had reached the city and was landing.

Webster, who was a pilot in the Marine Corps during the War, said the trip had not fatigued him any, and he proved it a few minutes later after he had reached the city by hopping off for Port Jefferson, L. I., where the Loening hangars are located.

"The weather was ideal this morning when we left Palm Beach," he said. "We ran into three heavy rainstorms, the first while flying over Georgia. We didn't mind the rain half so much as the fog which we encountered at various places along the coast. We maintained an average altitude of 1,800 feet, except when we hit the fogs, and then we were forced to fly lower. At times we flew only twenty feet above the surf to escape the fog. Fog and clouds were so dense over Pimlico Sound, North Carolina, and the Chesapeake and Delaware Bays that we had to steer a course by compass. The bumpiest air along the route was over Manhattan when we were describing an arc to land. We flew about 3,000 feet above the city."

CZECHO-SLOVAKIA WILL FURNISH RADIUM FOR 20 YEARS

The world's stock of radium will be larger in future years as a result of new discoveries in uranium ore fields of Czecho-Slovakia.

American Commissioner Breed, at Prague, has cabled the Commerce Department that the known supply of radium in the Jachcymov district will last 20 years, and that prospecting of new mining properties indicate production over a much longer period.

The Czecho-Slovakian republic's net profits this year from the sale of radium will be about 3,500,000 crowns. The republic is producing about two grams of radium annually. The price is approximately $100,000 a gram.

Commissioner Breed said that while radium production here is larger in quantity, the Jachcymov ores are richer in quality.

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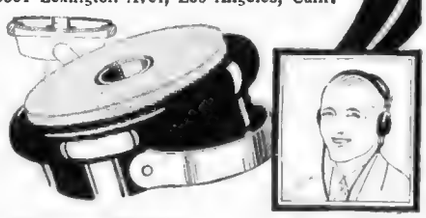

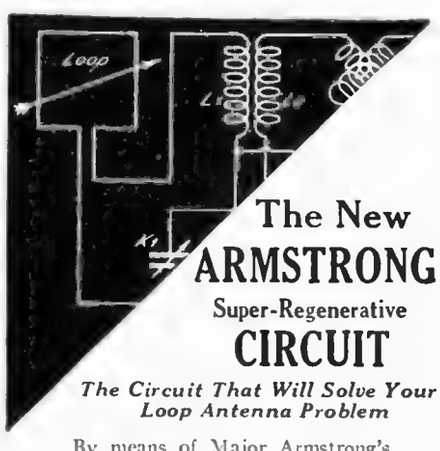

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Tony Sarg's Marionettes

(*Continued from page* 343)

prising the manipulating apparatus, which are held in the hand above the miniature stage, are attached to the various parts of the figure.

Fig. 2 shows a simple way of controlling the marionette figure, two strings being attached to the arms and a wooden cross bar, while the head is turned from side to side in this case by a thin wire secured to it, and ending in a loop which can be turned with the fingers. To make the figure walk, the wooden strip C is tipped from side to side with the left hand, while the figure is moved and manipulated with the double wooden cross-member held in the right hand. After the figure has been *walked* across the stage to the desired point, the strip C may be placed on the pin A, until the figure is to be made to *walk* again. The head is turned by moving the strip FF about the pivot A, while the arms are manipulated by raising the longer strip. It is a very good idea to arrange the marionette play in such a way that the dolls may sit on chairs or benches as much as possible, as it is easier to operate them while they are seated, the hands of the operator being left free from holding the leg-strings, for working the head and hand strings.

One of Tony Sarg's master stage tricks, which has puzzled many people who have witnessed performances of his marvelous marionettes, is that where a miniature actor actually smokes. Fig. 3 of our illustration shows how this trick is accomplished. Smoke is blown into a rubber tube which connects with a hole in the leg of a chair, a piece of tubing connecting the figure's mouth with the upper hole in the chair leg; the puppeteer behind the scenes puffs smoke regularly albeit periodically into the hose, and the puppet smokes as lifelike as can be imagined. Finally the figure arises and walks off, showing no tube or other connections.

The transformation of the *Countess Gruffanuff*, in the same play, from a hideous dowager to a beautiful young girl, and back again, is managed in an entirely different way. This puppet's face is an extremely ugly mask, which covers a beautifully modeled head, and is attached to it at the forehead. The lining of the ugly mask is made to represent a pompadoured coiffure, as shown in Fig. 4. At the moment of the transformation, the lights flicker for a second, the mask is quickly pulled up and turned inside out by means of the strings, revealing the beautiful face, framed in becoming pompadoured hair, which is the lining of the mask. No one ever guesses the method by which this transformation is accomplished.

Prince Bulbo, in Thackeray's *The Rose and the Ring*, drops the magic rose, stoops down and picks it up again—not a sensational puppet "miracle" to those who do not understand marionettes, but astonishing to those who do know the difficulties. See Fig. 5. It is done as follows. In *Bulbo's* hand is a loop of wire thru which runs a string which is attached to the magic rose, and holds up *Bulbo's* hand. An additional string is attached to his wrist. The rose is weighted with lead, and when *Bulbo* is ready to drop it, the string which holds the rose and holds up his hand is released: the hand falls and the rose drops to the floor, still attached to the string. *Bulbo* kneels, and touches the rose by means of the wrist-string, whereupon the puppeteer releases the wrist-string, pulls the rose-string, and *Bulbo* rises triumphantly with the blossom in his hand.

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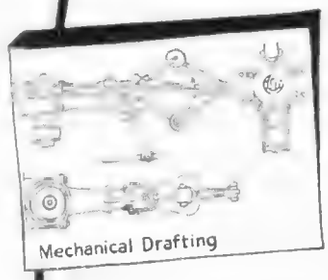

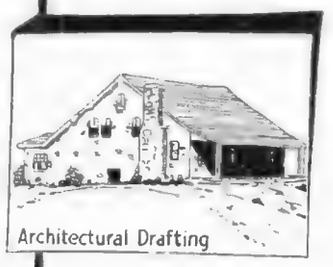

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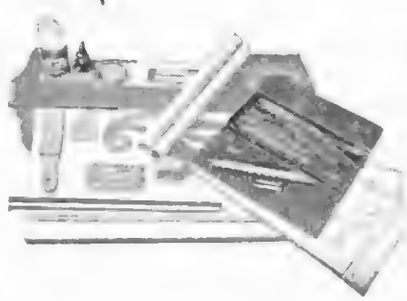

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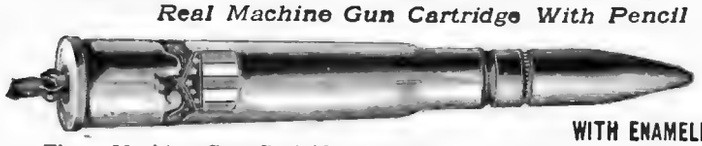

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Truth Enforced by Machine

(*Continued from page 342*)

a pneumographic record is taken simultaneously with the blood pressure. In addition to the rhythmitic rise and fall in the blood pressure produced by respiratory changes, there are certain irregular changes in the pressure curve which appear in certain persons, but these are best detected with the pressure slightly below systolic.

The blood pressure is taken with an Erlanger Sphygmomanometer, which has the advantage that a continuous record may be taken. It is a modification of this apparatus which Larson expects to make.

Also in his apparatus the time and the exact moment of asking the questions are recorded separately on two drums working together, which shows in the photo directly behind the girl's head. By the use of ordinates crossing all the lines, which shows directly at the subject's right hand, the heart beats and respirations can be recorded as well at the exact instant that the stimulus question or association word is applied.

One problem submitted for solution was to find out who, out of 100 girls living together in a large hall, was responsible for a series of thefts aggregating about $600.00. Suspicion had centered around three or four girls as the result of the thefts occurring near their rooms. All the evidence which the officer investigating the case had accumulated seemed to point to these girls, yet it was nothing but hearsay evidence. The blood-pressure test was given to which none of the girls refused to submit. Twenty-five of the girls were chosen from the one hundred and the test was purposely made without first ascertaining who might be responsible, so that the interpretation of the record might not be biased.

The test was divided into two series, in the first of which 12 girls were taken, including the three thought by the officer to be responsible. Of the girls examined, 3 were set aside for further investigation, as this first test was very short and was what might be termed a spotting examination. These 3 girls included the one who eventually admitted being responsible.

The irregularities in the tracings of the other two were but slight.

After the test was over, each girl was asked to carefully tell her real feelings and to analyze her emotions as far as possible during the test. The chief feelings were those of extreme interest, anger at the thought of possible suspicion, and worry or fear, and it is noteworthy that none of these emotions was intense enough to show upon the records.

The following statements and questions following it were used during the test:

(1) This test is to determine whether you are in any way responsible for the thefts committed at X. This test will prove whether or not you are telling the truth. The questions are framed with a view to obtain your emotional reaction to them. And in so far as it is possible we would like to have you analyze your feelings at the end of each question and explain to us later just what your feelings were following each question.

(2) Do you like college?
(3) Are you interested in this test?
(4) How much is 30 × 40?
(5) Are you frightened?
(6) Will you graduate this year?
(7) Do you dance?
(8) Are you interested in mathematics?
(9) Did you steal the money?
(10) The test shows that you stole it. Did you spend it?

(11) Do you know where the money is?

(12) Did you take the money while the rest were at dinner?

(13) Did you take Miss T's ring?

(14) Did you know who took Miss C's money?

(15) Do you know who took it?

(16) Are you accustomed to talk in your sleep when worried?

(17) During the past few nights do you remember having dreamed when you might have been talking in your sleep?

(18) Do you wish at this point to change any of your statements regarding the thefts?

All of these questions were asked each girl. With one exception the records of all the girls investigated showed a marked uniformity and except for rhythmic changes due to respiratory effects and one or two involuntary movements which were noted and indicated on the drum, no differences could be perceived between the effects of the indifferent questions and those appertaining to the thefts.

The record of the guilty subject showed on the drum by increased rate of blood pressure, increased rate of heart beat and many irregularities.

By the use of this apparatus upon most if not all of the criminals, the emotional changes can be found and a pretty close clue can be obtained as to the guilty party.

Automatic Pilot for Aircraft

By G. H. DALY, D. S. M.

(*Continued from page* 340)

The pipe from the left wing tip enters the circular groove just above the right hand surface of mercury and the pipe from the right wing tip enters the circular groove just above the left hand mercury surface, so the pipes are crossed. The groove is blocked up between the points where the two tubes enter.

Now supposing the 'plane turns to the left, the end of the tube on the right wing tip is moving faster than the end of the tube on the left wing tip, therefore there is a greater pressure on the mercury surface in the left side of the circular groove than there is on the mercury in the right hand side of the groove, thus air pressure counterbalances centrifugal force and the two surfaces of mercury remain at the same level when the airplane does a flat turn.

Connected across the 4-volt circuits are two pairs of electric lights—one pair for the elevator and the other pair for the ailerons.

Whenever the mercury closes either of the 4-volt circuits, a lamp glows. If, for instance, the 'plane tilts to the left, the mercury makes contact in the left hand 4-volt circuit and one of the lamps lights up and continues burning until such time as the 'plane rights itself again, when, of course, the mercury breaks circuit.

The great point about the Aveline stabilizer is that it makes flying a much safer proposition than it has been hitherto, for it not only dispenses with the human element in straight level flying, but it wipes out entirely the dangers that have always been present when flying in fog, clouds or at night.

When a pilot is flying in a fog, after a time he has very little idea what the airplane is doing. For all he knows, it may be flying in circles and the only indication is the compass and this may appear to have gone mad. But the difficulty lies in the fact that there is no certain way of getting out of this extremely awkward predicament. With the new stabilizer, however, such an accident would be impossible and with its aid an airplane can fly through the thickest fog, blackest cloud or darkest night, with the maximum amount of safety.—*Photos courtesy of "Flight."*

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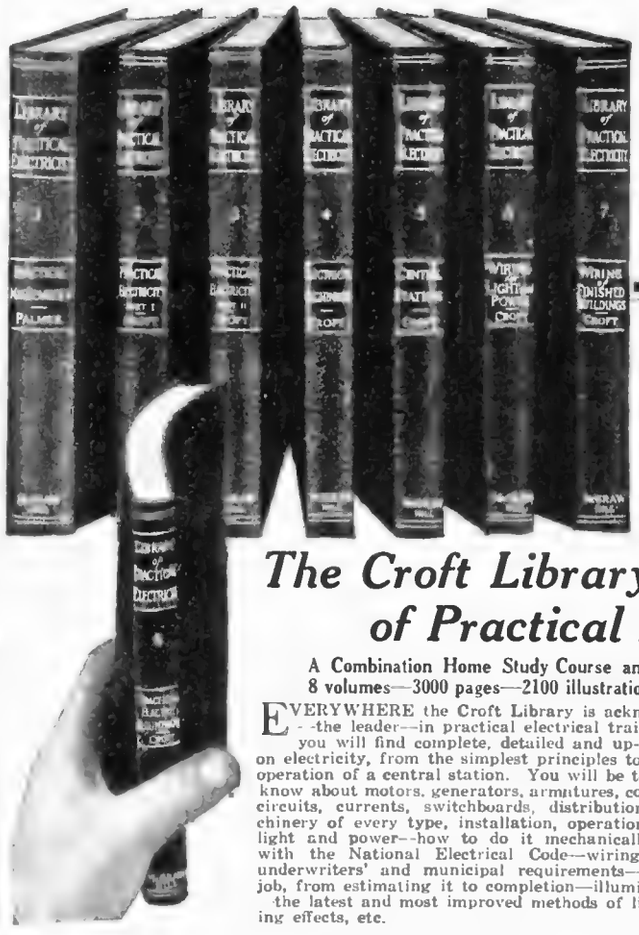

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Ship Fire Detector and Extinguisher

By ROBERT G. SKERRETT

(*Continued from page 322*)

flow steadily up from every cargo space, and the air, after reaching chamber A, is then sent to openings where it can be discharged either into the chart house or outside. Now let us see what happens when smoke is first generated in a freight-filled space, for instance.

Within a few minutes after smoking starts, say in Hold 10, the smoke is drawn up to chamber A of the detecting cabinet and is emitted from the flare marked, Hold 10. An ingenious arrangement, fitted with a mirror and lenses, projects upward the light of an incandescent bulb so as to illumine and to make more visible the column of smoke against the dead-black back and side walls of chamber A. Thus, a thin film of smoke is made conspicuous. Attention is further aroused to the smoke, which is always first expelled from the detecting cabinet into the pilot house by the sense of smell. The moment the man on duty discovers the smoke and its source, the proper valve in one or the other of the valve-control cabinets is brought into play.

The opening of this valve simultaneously closes the connection thence to the detecting cabinet and links the fire smothering line with either the boiler or a source of inert gas. Inasmuch as steam will injure many commodities, and carbon dioxide will not do so, the latter gas is preferred in the operation of the Rich system. This gas, liquefied, can be had in steel flasks carrying a hundred pounds of the gas. Such a quantity will, when released and vaporized, furnish a large measure of gas for fire smothering purposes. The gas is distributed into the endangered space by way of the bell-shaped hood or hoods thru which the warning smoke was previously led to the detecting cabinet.

It will be seen that it is not necessary to open hatches or remove intervening cargo to get effectively to the seat of trouble. It also is evident that a fire betrays itself almost immediately. To make sure that the fire is out, it is necessary only to restore the valve to its normal position, to shut off the gas or steam, so as to permit the exhaust blower to test Hold 10. Then, if the fire is not extinguished, the valve is once more opened and either steam or gas fed afresh into the cargo space until no smoke discloses that a menacing spark remains.

Unlike other fire-detecting installations, an outburst of flame does not impair the further effectiveness of the Rich apparatus. The usual types of thermostats are generally destroyed by the heat which causes them to give the alarm. All of the sensitive or refined features of the Rich apparatus are located remote from the holds and, therefore, well beyond any hurtful action of heat or flame.

The Eyes of Plants

(*Continued from page 341*)

not, the apparatus is void of energy and feeling. Photographic apparatus is a dead thing, but plants live! It therefore seems that the picture which is reproduced is comparable to that on the retina of the human eye, but this is absolutely false.

The human eye has its retina composed of innumerable delicate organs (rods and cones) independent and sensitive to light by which the picture, so to say, is brought into a mosaic. Then each of these light organs, sensitive to light, the rods and cones, as they are called, affect the nerves, carrying their reactions to the center organ, so that one single sensation affects the brain.

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But we find nothing of this sort in plants. It is true that on the back of these plant organs, an image of objects can be reproduced, at the back of the cell but is received by no real retina. If a man puts his artificial retina, the sensitized photographic plate, in a camera the exposure will give a picture as the man would see it if he had his retina along with his nerve connections in the place of the ground glass—so much and no more. But what good are these million times reproduced images to the plants? They are entirely useless, and nature never works without an end. The real object of the operation of these *plant eyes* is entirely in another direction. Plants need light: without light the required chemical reactions cannot take place. Even with diffused light alone they will not take place. The light must for certain of the decompositions attain a definite strength. It must be brought to a focus as if by a burning-glass. This is what takes place in the *plant eyes*. If an image is thrown upon the back of an organ, a minute image of the sun will be produced there also. In this minute reproduction of the sun, just exactly as in the case of burning-glass, there is a strong heat. It works upon a very minute area, and only for a short space of time, because the leaf is never perfectly quiet. Therefore it is that an overheating or burning is not to be feared, altho temperatures far above 100 degrees Centigrade may be produced. Plants thereby can easily be brought up to the boiling temperature if we take a superficial view of things. But this is not really the case. The minute area receiving images of the sun might easily be brought up to boiling and still higher. But its surroundings do not get heated directly with it, they therefore take away the heat from and conduct it away on all sides. An experiment of old times makes the case clear.

Tschirenhausen, who died in 1708, had convex lenses of a meter in diameter ground for his experiments. Of course they had no optical value as lenses are now rated, and their power of burning was proportionately slight. Tschirenhausen, a somewhat cruel investigator, amused himself by heating crabs in water on the bottom of the brook, in an attempt to boil them. The water in the immediate vicinity of the crabs was heated up to a boiling point, but on all sides above or below it remained cold. This is what takes place in the plants in millions of minute lenticular organs, so that the plant can either turn itself to the light, as sometimes happens, or instead of facing it can turn its edge to the sun to avoid getting an excess of the heat.

The assumption of the recognition by the plant of a picture is therefore quite unnecessary. It is enough when light or darkness can be distinguished one from the other. So the operation of the *eyes of the plant* is comparable with that of animals; not with that of the more highly developed mammals, but only with such *point eyes* as occur in the lower order of beings, snails and worms.

Usually the chemical reactions in the leaf only takes place by the action of light. Here we have to think of a photographer. The operation is surely simplified by the realization of the fact that plants grow even in shadows, that is, without direct rays of the sun. But in this case, the diffused light of the atmosphere is concentrated by means of the *eyes*, but the direct sunlight is requisite to the higher degree of growth because of the heat which it produces. Many would shake their heads over the high temperature which may exist in the center of a cold object. But the production of this heat seems not only possible, but follows out the laws of physics, and seems absolutely positive.—From *Kosmos*.

1,820,000 Telephones Moved

In the telephone business every day is "moving day." Telephone subscribers are probably the most stable and permanent portion of our population; yet during the past year one telephone out of every seven in the Bell System was moved from one place of residence or business to another at some time during the year.

The amount of material and labor, and the extent of plant changes involved in "station movement" are indicated by the fact that this item of service cost the Bell System more than $15,000,000 in 1921.

To most people, the connecting or disconnecting of a telephone seems a simple operation of installing or removing the instrument. As a matter of fact, in every case it necessitates changes in the cables and wires overhead or underground. It also necessitates changes in central office wires and switchboard connections; in subscribers' accounts and directory listings; and frequently requires new "drop" lines from open wires or cables.

The problems of station movement are among the large problems of the telephone service. Because of the double operation of disconnecting and re-connecting, the work involved is often twice as great as in the case of new subscribers. With nearly 2,000,000 changes a year, it is only by the most expert management of plant facilities that Bell service is enabled to follow the subscriber wherever he goes.

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This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general.

A glance at the following list of chapters gives but a very scant idea of the extensive and useful radio knowledge provided in its text:

The Induction Coil; The Alternating Current Transformer; Radio Transmitting Condensers; The Spark-Gaps; Radio Transmitting Inductances; Radio Receiving Tuners; Radio Receiving Condensers; Detectors; Telephone Receivers; Radio Amplifiers; Construction of a Direct Reading Wavemeter and Decremeter; Antenna Construction; The Calculation and Measurement of Inductances; Appendix containing very useful tables, covering all subjects treated in this very unusual book.

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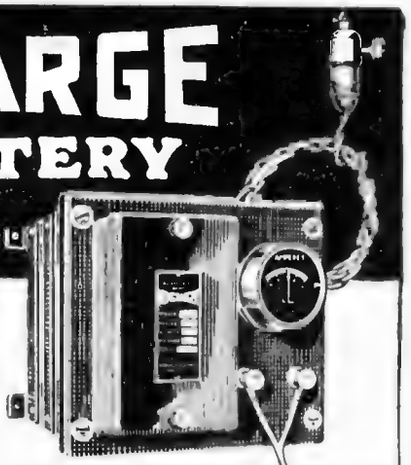

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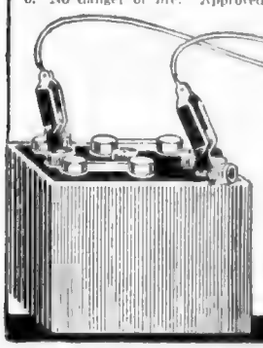

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Unlimited Destruction

By ERNEST K. CHAPIN

(*Continued from page 332*)

said he as the latter entered, "you know my favorite diversion. Bring me something new that you have filed in the case labeled 'Letters from Cranks.'"

"Here are several, sir," said Digby a moment later as he brought in a handful of letters. "This one is from a crank who wants to know why taxes are so high since the mint which makes all the money could easily make enough more to meet not only all governmental expenditures, but supply every man, woman and child with a bank roll besides."

"Old stuff," snorted his excellency in disgust.

"Here is another from a man with a sure cure for crime. He will sell his idea for a million dollars down and a million a year. The government will profit, he assures us, to the extent of the many millions which are now spent annually for prisons, police, etc."

"Marvelous, indeed," replied the president, "but I have received that type of letter at least a dozen times and it has ceased to amuse me."

"Well, this one, then, is unusual to say the least, although it comes from one who must be in a more abject state of insanity than is usually the case with our friends, the cranks. At first I thought it too absurd to mention."

The president's fingers darted out and the next moment he read:

"LONESOME ROCK, PACIFIC OCEAN,
"June 14, 1934."

"PRESIDENT H. E. SEABURY,
Commander-in-chief of the
Army and Navy.

"DEAR SIR: Within two weeks from date the United States Navy will be completely destroyed by a means known only to myself and in a manner which no man can prevent. If you wish the destruction to take place in the American harbors or near the coast where great loss of life and property will be inevitable, you only need to ignore this note and repent your neglect later. On the other hand, if you possess the discretion with which I give you credit you will order the fleet to depart within two weeks for the Pacific Ocean accompanied by convoy ships to which the crew can be later transferred. The ships on starting forth will be guided by wireless signals from my station on Lonesome Rock to a spot far removed from land. Here the crew may either sink the ships as they are abandoned or leave them to be destroyed by me.

"Sincerely yours,
"CAPTAIN RAY."

"Well of all the colossal nerve," exploded the president and then he burst out laughing. "Guess I'll have to have some copies made of this and sent to some of my navy friends. It may cheer them up a bit to know they are about to be put out of a job."

Two days passed by, the war cloud lowering every hour. The nations spent the time scrambling to be first into the war harness and several fleets were already under steam and headed for the Pacific Ocean in anticipation of hostilities. The papers were full of ominous news and the very atmosphere was charged with excitement as each extra added its weight of conviction that the world was war-bent. A Japanese fleet was well on its way toward the Palmolas, an opposing fleet was hastening toward the same goal and a clash was expected hourly. In the White House the president and his secretary labored diligently while there was any hope of preventing an outbreak, but at the same time knowing full

well the hopelessness of the situation they made every effort to prepare the nation for a great war. It was in the midst of these preparations that the president was interrupted in his office by the entrance of Bushworth.

"Has the first shot been fired?" inquired the president anxiously.

"No," replied his secretary, "but the first battleship has been destroyed."

"Sunk?"

"No, blown up, gassified, completely disintegrated, if you get my meaning."

"Not exactly, Bushworth; you know I hate exaggerations."

"Read this, then," he said curtly, tossing a cablegram to the president. "It tells all I know about it."

As the president read a bewildered look spread over his face. "Ask Dr. Stanton to come here at once," he called to a page who appeared almost as his fingers touched the button. Then reaching for the telephone he called Georgetown University and engaged one of the scientists there in an animated conversation.

"Is this Dr. Barker?" he asked when a voice answered. "Well, this is Seabury talking. I wanted to know if any unusual disturbances have been recorded by the seismograph today . . . . You say one has, very violent in character? . . . Most extraordinary . . . . You don't think it could be attributed to volcanoes or earthquakes? . . . . Well, well, at what time did it happen? . . . . Most remarkable, Dr. Barker, for at the same time the Japanese dreadnaught *Kitska* was destroyed in the Pacific with great violence and in an unaccountable manner. A rock or small island was also blown up or disintegrated, as the cable states, and I thought that if the force with which it was destroyed was as great as reported, some trace of a vibration caused by it might be detected by your instruments. Your testimony makes it seem probable that the account is not overdrawn. Please notify me if any more such records are received. Thank you."

"Bushworth," he said as he hung up the receiver, "there must be some mistake. I am little acquainted with the physical sciences, but common sense, if I have any, tells me the thing is preposterous, too chimerical for belief."

"I felt the same way that you do about it, Mr. President, but the cablegram is authentic enough, and as you said the record of the earth's vibration at the moment of the destruction substantiates the account very well. But here is Dr. Stanton. He can surely tell us if such an episode is possible."

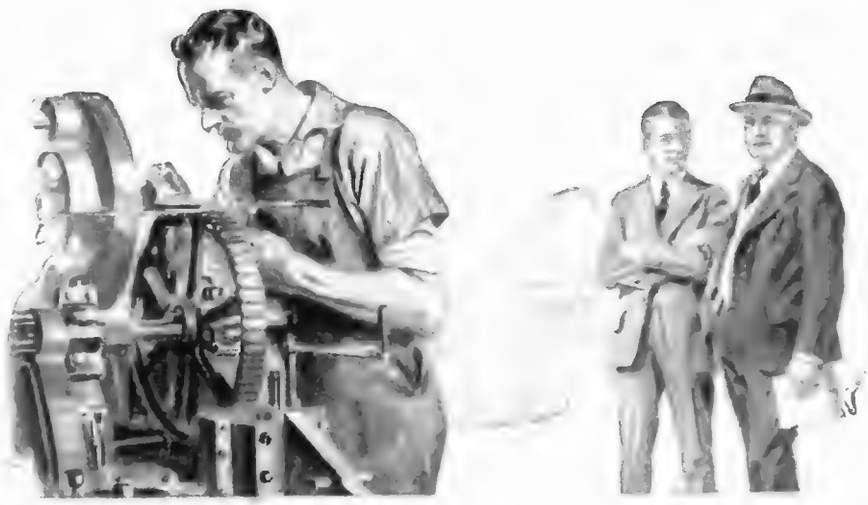
"Have a chair," urged the president as the eminent scientist entered. "I have summoned you because I need the opinion of one with the knowledge, experience and mental stability of a reputable scientist. Let me lay the facts before you," he said, handing him the cablegram. "Tell me if you think that yarn can be true."

Taking the message from the president's hand, Dr. Stanton read as follows:

"HONOLULU, HAWAII.

"Wireless dispatches from the Japanese fleet in Pacific waters state that the flagship *Kitska* was destroyed this morning by some powerful and unknown means while en route to the Palmola islands. Warnings of its coming destruction were received by the wireless operators shortly after the fleet left Japan in a queer message from one proporting to be 'Captain Ray.' In this message Captain Ray instructed Admiral Katsizumi to take his ships to a point far removed from land, remove his crew and leave the fleet to be destroyed by Ray. As the order, though striking in character, came from an unknown and unauthorized source, no attention was paid to it. Nothing further of unusual nature was noticed for several days.

"On approaching the Peel islands, however, an odd-looking craft was sighted rapidly nearing the fleet. It was shaped



"He's Patented Four Inventions"

"FUNNY thing, too . . . When he first came here he was just an ordinary worker. For a time, when things were slack, I even thought that we might have to let him go.

"Then, gradually, I noticed an improvement in his work. He seemed to really understand what he was doing.

"One day he came into my office and said he had worked out a new arm for the automatic feeder. I was a little skeptical at first, but when he started explaining to me, I could see that he had really discovered something. And when I started questioning him, I was amazed. He certainly did know what he was talking about.

"So we sat down and talked for over an hour. Finally, I asked him where he had learned so much about his work. He smiled and took a little book from his pocket.

" 'There's no secret about it,' he said. 'The answer's right here. Four months ago I saw one of those advertisements of the International Correspondence Schools. I had been seeing them for years, but this time something inside of me said, *Send in that coupon.* It was the best move I ever made—I knew it the minute I started my first lesson. Before, I had been working in a sort of mental fog—just an automatic part of the machine in front of me. But the I. C. S. taught me to really understand what I was doing.'

"Well, that was just a start. Three times since he has come to me with improvements on our machines—improvements that are being adopted in other plants and on which he receives a royalty. He is certainly a splendid example of the practical value of I. C. S. training."

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There has been something of an evolution in advertising in the last few thousands of years, but the principle is just the same.

The *consistent* reader of the advertisements is invariably best informed on what to eat and where to get it; what to wear and how much to pay for it; what to do and how to do it. He's up on the most important things in life. Consequently he gets most from life.

Throughout the ages, advertising has done much to make life livable and pleasant. We owe it much.

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something like a seaplane with a long body, possibly a hundred feet in length and about fifteen feet in width. From near the front extended a single pair of planes. No engine or propeller could be seen, although it seemed to have a most powerful exhaust, which could be heard as a loud continuous hiss issuing from the rear. Sometimes this flying boat skimmed rapidly over the surface of the water, but usually it flew high in the air like an airplane. Its speed was prodigious, about 300 miles per hour, according to Admiral Katsizumi's estimate. Set in the front of the body like a green eye of some cyclopean monster was what appeared to be a large reflector or headlight, which glowed with a peculiar greenish phosphorescence.

"As this remarkable craft approached the *Kitska*, which was about ten miles in advance of the rest of the fleet, a wireless message was received ordering Katsizumi to remove his men at once to one of the Peel islands. This message, like the previous one, was signed 'Captain Ray.' The admiral declined to do so, but urged the mysterious captain to come aboard the *Kitska* and make himself and his purpose known. Instead of replying to this invitation, however, Captain Ray shot forward in his unique machine to a rock that stands out alone near one of the islands. For a moment he could be seen adjusting some sort of apparatus in the cockpit, then suddenly he switched the machine around until the nose pointed directly toward the rock. From the solitary glass eye a blue-green pencil of light shot forth, quivered for an instant on the surface of the boulder, and as quickly disappeared. Almost instantly from the rock flashed skyward a blinding light accompanied by a report louder by far than any explosion. The crew, at first stunned by the shock, were the next moment deluged by a huge wave that completely swept over the vessel, washing many of the men into the sea.

"For awhile it was every man for himself, but after recovering a little from their surprise and fright the crew set about rescuing those members who were swept overboard and then piling into the lifeboats, they made for the nearest island. Scarcely, however, had they reached the shore when a report even louder than the first was heard and the *Kitska* disappeared in a tower of white smoke and dazzling flame. Again the reaction set in motion a wave which swept like a wall of water in all directions from the disaster with terrific speed. On encountering the land it passed entirely across it, overturning trees and uprooting vegetation in its path. As the islands are uninhabited no loss of life resulted, although there were numerous injuries among the men who had just reached shore from the ill-fated *Kitska*.

"The refugees were soon cared for by the other ships as they came upon the scene. As for Captain Ray, nothing further has been seen of him, though the morale of all the sailors has been badly shaken in the dread of his return."

"Well, Dr. Stanton, what do you make of that?" asked the president.

"Is it fact or fancy?" added Bushworth. "Do you consider such a thing within the realm of possibility?"

"I do," declared the scientist slowly. "It means that somebody has learned how to release interatomic energy, or the energy stored in atoms. Students of radioactivity and atomic structure have for many years predicted that the day would come when mankind could release almost unlimited energy from even common substances—iron, water, air, anything. In all seriousness I tell you there is enough interatomic energy in each breath you draw to blow up a battleship like the *Kitska*."

At this the president and his secretary exchanged glances. One closed an eye in a knowing manner and the other tapped his head with unmistakable significance.

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Oh, I know you must think I am crazy," Dr. Stanton hastened to say, as if he guessed what was passing between them, "but let me give you some facts which show that my statement was not altogether wild and fanciful.

Since 1903, when Curie and Laborde concluded their epoch-making discoveries, it has been known that a small quantity of radium, a gram to be definite, will maintain itself at a temperature of about 2.7 degrees Fahrenheit above its surroundings. In other words, without receiving any energy from outside itself, it gives out heat at the rate of 100 gram-calories per hour and continues to do so for over 2,000 years. It is like a stove that stays hot for twenty centuries without receiving any fuel. Now without burdening you with figures I am sure that you can see that we can definitely determine the total quantity of energy contained in this substance and can speak with absolute assurance of the tremendous energy which it contains."

"But how can such a small quantity of matter deliver this energy?" objected Bush worth.

"You are familiar, no doubt, with the fact that a moving object possesses energy of motion or kinetic energy," explained Stanton, turning toward the secretary. The faster a body moves or the heavier it is the greater is its energy. In fact, the energy of a moving body depends more upon its speed than upon its weight, for if its weight were doubled its energy would be twice as much, but if its velocity were doubled its kinetic energy would be four times as great. Thus it is possible for even a very light particle to possess considerable energy if its speed is sufficiently great.

"Now that is precisely the case with the particles that fly out of radioactive matter. The alpha particles that are expelled from a disintegrating atom pass with a velocity sufficient to carry an object nearly around the earth in a single second and the velocity of the beta particles is far greater. It is these amazing velocities, together with the prodigious numbers in which these particles appear, that account for the unbelievable store of energy in radioactive matter."

"But is not this energy confined to a few rare substances, like radium?" inquired the president.

"Probably not," replied the scientist. "In fact, there are many indications that all matter contains similar stores of energy, but it is only in the case of the radioactive elements that it is released at an appreciable rate. Thus J. J. Thompson has figured that a single gram of hydrogen (an amount having less than the weight of a dime) contains considerably more than 300,000,000 foot tons of energy—enough to place the heaviest locomotive in the world with a long train of loaded coal cars on the top of Mount McKinley."

"Incredible!" gasped the president. "Surely, Dr. Stanton, you don't expect us to believe it?"

"Perhaps not," replied the scientist coolly, "if these statements are unfamiliar to you, but let me remind you that credibility or incredibility does not in any way affect the truth or even the reliability of a statement. Personally I would be very much inclined to believe any statement, if the worst that could be said about it is that it is incredible. Stop for a moment to reflect and you will see that there are a multitude of things that you accept as everyday facts which are absolutely incredible. For example, you believe that we are living on a globe nearly 8,000 miles in diameter, the other side of which is inhabited by people who must perforce be standing with their feet pointing upward toward us and their heads hanging down the other way. This is perfectly incredible, yet you not only believe it, but would consider any other notion ridiculous. You believe further that the great continents and

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oceans of the earth, this city and countless other great cities with their teeming millions, are being whirled eastward with the speed of a thousand miles an hour, while at the same time they are all carried at the rate of 18.5 miles a second around an object 93,000,000 miles away. Incredible, isn't it? Yet do you doubt it for a moment? Familiarity breeds contempt, as the saying is, and the dramatic and spectacular of today will be drab commonplaces of tomorrow."

"But don't you suppose the destruction of this great battleship can be accounted for in some other way, by some powerful chemical reaction perhaps?"

"I must confess I do not," answered Stanton deliberately. "The most powerful chemical reaction known to chemists today occurs when the gases hydrogen and oxygen unite in the proportion 2 to 1 to form water. It would be difficult, indeed, to imagine how sufficient quantities of these gases could be placed and liberated so as to produce the results observed. Interatomic energy, on the other hand, would easily account for it. In fact, the surprising thing is how the energy could be released without producing a tidal wave that would wreck all the coast cities of the world. For if the interatomic energy of the battleship itself were released the reaction would produce just such a wave, if not one much more powerful. For remember that the interatomic energy of radium emanation as invisible gas is 3,500,000 times as great as the chemical energy of the most explosive mixture known today. In other words, if the battleship were made of nitroglycerine of a variety a million times as powerful as any now made and if it were then exploded the reaction would be nowhere near as great as it would be if the interatomic energy of the entire battleship were suddenly released."

"Well, well, Dr. Stanton, you have tried hard to convince me of this seeming impossibility, but as you know I am both physically and mentally 'from Missouri' and I have to be shown, but here is Digby with another cablegram."

"Another note from your friend on Lonesome Rock, Mr. President. The other one amused you so much I thought I'd bring this one right in."

Unfolding the sheet at once the president read:

"LONESOME ROCK, PACIFIC OCEAN.

"PRESIDENT H. E. SEABURY.

"DEAR SIR: I understand that the United States fleet in the expectation of war is preparing to depart soon for the Pacific. Do not fail to have sufficient convoy ships accompany the fleet, as otherwise no safeguard can be given the sailors when the navy is destroyed, as it surely will be.

"CAPTAIN RAY."

"Well, what in the name of common sense is the meaning of these notes? Who is this Captain Ray anyway? Why did he destroy the *Kitska?* Above all, why should he seek to destroy the United States Navy, too?" gasped the president.

"Perhaps he is seeking to aid Japan's enemies," suggested Bushworth, "and if he looks upon the United States as a potential ally of Japan he would naturally wish to cripple her at the start. With the aid of his mysterious blue-green ray he could easily undertake the conduct of the war alone, and I for one wouldn't give a fig for the chances of the other side."

"I doubt very much if he is undertaking to back any particular group of nations in this war," answered Stanton, "because the facts are against that possibility. In the first place, the United States is still neutral and from all appearances is as likely to be arrayed ultimately against Japan as on her side. Besides, I saw by the papers, just before I came in, that all the naval powers of the earth have received notes similar to

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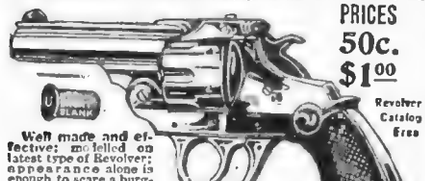
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the one just read, calling upon them to abandon their battleships in the middle of the Pacific and permit them to be destroyed. The press has been making a great joke of the letters, but the attitude will doubtless change now that some exhibition of Ray's power has been made."

"But what motive can you ascribe to Ray, Dr. Stanton?" asked the president.

"The desire for world domination," replied the scientist. "Do you not see that if Ray possesses the knowledge of how to liberate and control interatomic energy, as indeed he seems to, he could single-handed annihilate the armies and navies of the earth and put himself in complete control of human destiny on this planet? He has the power of unlimited destruction and no one would dare to touch him. He can direct his ray toward iron and it will at once become a million times as explosive as dynamite. He can flash it on a piece of stone and convert it almost instantly into helium and hydrogen, which on being liberated will expand with terrific disruptive force. Even human flesh would disintegrate when it is touched with this magical light. Indeed, Mr. President, without meaning to be a crape-hanger, it may not be many days before our friend on Lonesome Rock sets up a despotism more absolute and unshakable than any that has ever existed on the earth. It may not be long before we will receive directions from Captain Ray to come and go or fetch and carry like humble slaves before an all-powerful monarch. If he wishes gold he need only ask for it and the treasuries of the world will be opened and their contents poured at his feet. If he takes a fancy to diamonds and pearls the rich and fair of the earth will strip their ornaments from their bodies to satisfy him. Anything he desires will be his for the asking, for he possesses the power of unlimited destruction. What will a man not give in exchange for his life?"

"You overwhelm me with these dreadful possibilities, Dr. Stanton. I confess I am at a loss to know what to do. Surely you do not expect me to take it for granted that Captain Ray is actually going to do the things he threatens? You don't expect me to send off our great navy to the middle of the Pacific Ocean and surrender it without firing a shot to an unknown man merely upon his demand. How ridiculous! Even if I were sure he possesses the secret of interatomic energy I could not persuade the public of the fact, and to send off the navy on such a wild-goose chase would mean that I would soon find myself either in an insane asylum or astride a bar with a coat of hot tar and feathers on my back. The people wouldn't stand for it."

"Of course they wouldn't," agreed Dr. Stanton, "unless they were convinced of the peril in which they would place themselves by retaining the navy, and doubtless Captain Ray understands this as well as you do. It seems quite likely that he will organize a course of instruction for the benefit of the public. The destruction of the *Kitska* is only the first lesson and we may expect similar lessons to follow shortly. After a few superdreadnaughts have been blown up or disintegrated you will be in a position to inform the public of the demands that have been made and let them decide for themselves what action to take."

"But in the meatime—" began the president.

"In the meantime why not wire agents on the Pacific coast or in Honolulu to organize a search party to see if they cannot locate Captain Ray. Possibly they can capture him, or destroy his marvelous flying-boat, or at least gain some information of his motives and the extent of the power which he possesses. Since he has started to destroy foreign ships let him proceed. I see no way of preventing him. Perhaps something will turn up to our advantage before he begins on ours."

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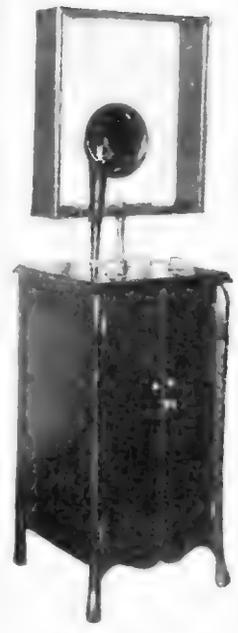
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"Very good, Dr. Stanton, that sounds sensible enough, but how under the sun is this expedition going to know where to look?"

"Oh, that is not so difficult as it seems, Mr. President. Doesn't Captain Ray do his communicating by wireless from Lonesome Rock?"

"Yes, he does."

"Well, then, have several wireless stations along the Pacific coast, including the one at Honolulu, listen in for his next message and take bearings on his station with radio compasses while he is sending. Instruct them to cable their results to Honolulu at once and from their bearings the search party can determine not only in which direction to travel, but also how far they will have to go before they will reach his station."

"Excellent, I'll wire Captain Norton of the *Arrow* at once. Thank you, Dr. Stanton, for coming in. I'll let you know if any new developments turn up and I am sure I can count on you if I need your advice."

A few more days passed by—days of tremendous importance to the peoples of the earth, for in that brief time no less than seven great nations declared war on each other, pledging the last cent of treasure and the last drop of blood to bring the war to a righteous conclusion. More nations were expected to follow suit and speculation was rife as to which side would win the balance of power. From Europe came reports of great military preparations, of mobilization of troops, of the strengthening of fortresses, of the collecting of supplies and of plans of action. Belgium was to be overrun. Holland invaded. Poland crushed and portions of the Balkans trampled under foot if resistance was offered.

In the Pacific events were progressing even more rapidly. A naval battle was in progress near the Palmolas. French, British and Italian fleets were hastening to the scene. A great naval clash was imminent. But suddenly the war preparations slackened a little and the pulse of the world lost a beat as a greater danger than war faced it, for the news was flashed over wires and through the ether that the dread Captain Ray was again operating with his mysterious flying-ship. More battleships had been sunk. The account as given in one of the dailies ran in part as follows:

"Captain Ray at first approached a large British superdreadnaught and telegraphed the commander to remove his crew to another vessel. In reply the commander sent a shot whistling in his direction. Although the shot came dangerously close, the captain did not seem disturbed in the least, but he carelessly cast a small soap box overboard. Then darting backwards quickly he focused a beam of colored light from the front of his machine on the harmless looking box In an instant a deafening report rang out as the very atoms of the box exploded, throwing out trillion of trillions of flying particles into the air. It was very much as though a huge bomb were exploded at the surface of the water.

"The effect upon the crew was electrical. Without waiting for orders from their commander they made for the lifeboats and scrambled over the railing and in a few minutes the great ship was deserted. As soon as the sailors reached other ships the mightiest of the British battleships followed the spectacular fate of the *Kitska*.

"The next victim was a French ship. In this case no demonstration was necessary for the destruction of the Japanese and British vessels was common talk on all the rest, and as soon as the mighty Captain Ray appeared the commander withdrew his men without a show of resistance."

Another and yet another ship was destroyed and by this time the works and wonders of Captain Ray had made such an impression on the whole world that little else was talked of. "Who is this Captain Ray?

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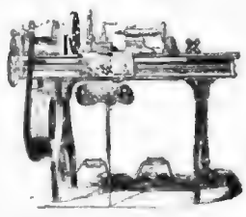

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Why is he in the business of destroying battleships? And how does he do it?" were questions on the tongues of everyone. Of the many motives assigned for his queer procedure few seemed plausible and none seemed in any sense likely until the motive suggested by Dr. Stanton was made known. Then it was that the papers used their largest type in their headlines to call attention to the noted scientist's views on the matter.

WORLD DOMINATION RAY'S MOTIVE DECLARES STANTON

appeared in glaring headlines to an astounded public just awakening to a realization of what a power of unlimited destruction might mean. The press followed up its announcement of Dr. Stanton's views with voluminous descriptions of what the state of human affairs was likely to be in a short time if nothing was done to prevent it, and public speakers, anxious to unite the country in some attempt to combat the sinister force that seemed likely to dominate mankind, waxed eloquent in their support of one or another suggested plan. Some counseled resistance. "Let us fight to the last man," they urged heroically. "Better to die as men than live as slaves. Let the battleships fire broadside after broadside and volley after volley at his cursed flying-machine. They are sure to make a hit sooner or later and the world will be saved." But little did they know of the difficulties. They had not seen Captain Ray at work. They had not seen his mysterious blue-green ray. They could not imagine what the disintegration of a battleship would be like. They did not know how helpless the navies of the world were, how childish the most powerful guns appeared, how weak and impotent the most terrible of man's inventions for destruction became in the presence of this arch magician, who could make the very earth underfoot explode or create a storm that would wreck in an instant any air fleet sent against him.

Other speakers, more timorous, urged immediate surrender of all the battleships, fearful lest the dreaded captain enter the harbors and cities, cast his baleful beam on their homes and skyscrapers, setting them in flames and killing thousands of men, women and children.

As the next two days wore away the panic in all nations increased for report after report came in of battleships and cruisers sunk or disintegrated. Few commanders dared offer much show of resistance, realizing that in this case at least discretion was the better part of valor, but whenever any opposition was made Captain Ray exhibited in some effective manner his unlimited power and sent the crews flying for their lives. Sometimes he sent great waves against a ship that threatened to overturn it. At other times he would cut down the effect of his ray so as to produce only a local and moderate explosion. Yet this moderate explosion might rip off ten feet of armor plate and start the ship sinking. Of human life he always seemed sparing, although no one doubted but that he would send a thousand men to their graves if they persisted in remaining on a vessel which he chose to destroy.

No particular nationality seemed to be favored in any respect. French, British, Japanese and Italian battleships alike went to the bottom of the ocean or were blown into fragments. No American ship had yet been destroyed for America had not yet sent its fleet to the Pacific, but considerable anxiety was expressed as the time came for the ships to be either sent voluntarily or destroyed in the harbors, for the two-week limit, well known to the public by this time, was nearly up.

It was in this state of affairs that we again find the president and Dr. Stanton in conference.

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"Well, what luck did your expedition have, Mr. President?"

"What expedition?"

"Why, the one you sent to capture Captain Ray."

"Oh, they did about as well as could be expected. Captain Norton found Lonesome Rock all right. It is a solitary island several hundred miles from Honolulu. It was deserted, although it had been evidently occupied by a man of scientific habits. There was a physical laboratory, well equipped with every device imaginable for research work along the lines of radioactivity and ionizing radiations. There were blue prints also of Ray's marvelous flying-ship with evidence that interatomic energy was used as motive power, but Norton was not much of a scientist and could not understand the workings of it in the least. He waited around for a number of days, keeping a sharp lookout for Ray, but soon his provisions gave out and he returned to Honolulu to report. I have just sent him back with a larger ship and with instructions to remain on Lonesome Rock until Ray returns if he has to wait a month."

"It is too bad Norton couldn't find out how he is able to release and control this energy," sighed Dr. Stanton. If we could only steal his secret from him we would be in position to laugh at his imperious demands. We could meet him on his own ground and possibly outdo him at his own game. Think, too, of the advantages that would be enjoyed by mankind if we possessed the knowledge that he does. All our machinery, all our vehicles of transportation could be run by interatomic energy. A handful of sand would run the railways of the country several hours, a cup of water would do the work of tons of gasoline. Everybody could have aeroplanes and automobiles all run by interatomic energy. Everybody could travel. No need to fear a coal shortage, the air we breathe could be made to take its place in heating our homes. Why, it would revolutionize industry, it would usher in—" but just then the door opened and a page entered with a card.

"Professor Pingree," gasped the president. "Show him up at once."

A moment later a tall man with a close cropped beard and piercing brown eyes entered. For a moment both Stanton and Seabury gazed at him with unbelieving eyes. Then with one accord they reached forward to seize him by the hand. "Welcome back from the grave, old comrade," said Stanton with warmth. "The last the world heard of you was that you had been lost on a geological expedition to the Canadian Rockies. What have you been doing with yourself all these years?"

"For the most part I have spent it on Lonesome Rock," answered the visitor quietly.

"Then you are Captain Ray?"

"The very same."

"And you—you destroyed all those ships?"

"I'm afraid I'll have to plead guilty," he answered.

"And you intend to destroy the United States Navy next?" asked the president quickly.

"I do, unless the American people can be persuaded to destroy it themselves."

"Why, nonsense."

"Not at all. Only today I finished destroying the major navies of the world. Why should the United States maintain a great navy any longer now that there are no fleets left to fight?"

"Well, that may be, but why do you propose to destroy it anyway?"

"For the same reason that I destroyed the others—that the world may have a breathing spell from war."

The president's jaw dropped in surprise and even Stanton looked astonished. "Do you really mean it?" they both asked in a breath.

(*Continued on page 393*)

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Tape Phonographic Record

(619) K. Gudbrandsson, of Winnipeg, Canada, submits a sketch of a phonographic recording machine in which the sound is reproduced by a selenium cell; the voice being recorded on moving paper tape.

A. The idea is not new. It has been tried time and again and is fully covered by patents. Unless a new form of recorder or new style of reproducer is used, we doubt very much if you could obtain a patent upon this suggestion. Since the selenium cell does not lend itself very well to such work, and masmuch as the sound will not reproduce very loudly, it would be necessary to incorporate some form of amplifier in the phonograph. This would make the device entirely too expensive for home use, consequently, the system will have practically no commercial value.

Selenium Door for Safes

(620) Wm. Carnvin, of Chelsea, Mass., asks:

"Is there any patent on a safe with a selenium door which, when light from a search light is cast upon it, will close a circuit and ring a bell due to the peculiar quality of the selenium of causing more current to flow when exposed to light."

A. Altho we know of no such safe, we do not think that the application of selenium to the same would warrant a patent, as anyone can secure selenium cells and install these devices themselves. In addition to this, it must be remembered that at whatever time of the night a light is turned on in the room, the selenium cell will close the circuit. Unless some clock-like arrangement is installed to automatically break that circuit in the morning before sunrise the selenium cell will again cause the bell to ring the instant that the sun peeps over the hill top. Should an automobile pass in the night and its head light penetrate to the safe, another alarm will sound, and what is to prevent a burglar from covering the same, particularly when he has established the lay of the land and knows of hte existence of the cell? In our opinion the idea is worthless.

Metal Polish

(621) John Gray, of Brownwood, Texas, asks.

"Could a metal polish composed of mother of pearl from mussel shells which are easily and cheaply obtained from the beds of small streams and ground into fine powder be patentable?"

A. While this might be practical, it could not be patented. If you desire to place it on the market, you could do so by following the ordinary trade mark proceedings, or forming a company to manufacture and market the same under a trade name.

Ice Tongs and Scale Combination

(622) Charles Gillen, Jr., of Pierce City, Mo., submits a sketch of a proposed device and asks:

"Is there a patent on an ice carrier with scales to weigh the ice, and if not, do you think a patent could be secured on the same?"

A. We believe that you can obtain a patent on this suggestion. The device will have to be carefully adjusted and the weight of the tongs taken into consideration. Allowance must also be made in case the iron tongs are later ground to a point and a standard weight provided to go with the device for repeated regulation should be supplied. The suggestion is very good and we would advise further research along this line.

Protractor

(623) Geo. Glasgow, of Sour, Texas, submits a sketch of a rule and protractor and asks:

"Can I get a patent on a piece of sheet glass cut as shown in the accompanying diagram. It is bent and attached to a folding rule, where it is held firmly in place by means of teeth. A small iron peg is driven into the rule at a point which is on line at a 45° angle from the edge of the rule. Different angles are marked on the dial. By bringing the edge of the rule to the mark of the required angle, it may be used as a T square or bevel."

A. We do not believe that you could possibly secure a patent on your contrivance, nor do we think it of any value whatsoever. The device does not perform any of the functions to make it adaptable to the mechanic and the amateur can not use it. A simple protractor of metal or celluloid is cheaper and more substantial.

Fire Alarm

(624) G. J. Frankovich, of Anaconda, Montana, asks:

"What do you think of the following invention? Cotton to keep powder air-tight is placed over a small chamber containing said powder, which is at the base of a hollow pipe containing an iron weight which moves up and down. A long fuse is run around the room and connects with the powder chamber. A fire started in the room would, therefore, ignite the fuse and then the powder, which would expand in the form of gas and would push the iron weight upwardly and close a single pole single throw switch thereby ringing bells.

A. In the first place, the setting off of the fuse requires that a flame come in actual contact with the fuse, which means that the fire will necessarily have obtained considerable headway. The device is impractical because of the fact that an explosive is used in actuating the mechanism. Explosives cannot be sent out in the mails, and so the device cannot be sold to out-of-town customers. The re-setting of the instrument is likewise quite expensive, when one considers the amount of fuse which has to be laid. The burning fuse and powder is an additional fire hazard. This system is entirely non-suitable.

Mariner's Automatic Ship Steering Compass

(625) O. Ferrell, Jr., of San Antonio, Texas, asks:

"I have a device which is intended to automatically steer a ship without a man at the helm. The course indicator is connected to the dial of a compass by means of a shaft and cog wheels. The indicator is adjusted to the desired course, and when the ship departs from the predetermined course, a circuit is completed which changes the position of the rudder, thereby causing the ship to come back on its course. Is it of any value?"

A. The idea which you have advanced, altho quite feasible, does not compare with the modern systems of similar design, and is nearly identical with the Andrias compass, except that the latter does not use the intermediary gears. The gyro compass is not subject to the inaccuracies found in the magnetic compass, and likewise is suited to this work.

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Radio Spark Gaps

(626) Eugene Feinberg, of Fort Smith, Ark., submits diagram of a spark gap for radio and asks: "What value would such a spark gap have considering it from the selling standpoint? Could it be patented?"

A. Without a doubt, this device can be patented, but what will be the use? To-day an open spark gap is not employed for radio nor for any other purposes, except in a few high frequency machines. Within another year or two spark gaps will probably be relegated to the other early devices of old time radio and, therefore, we advise most strongly against attempting to patent this scheme.

An Ambiguous Question

(627) Henry Goldblatt, Chicago, Ill., asks: "Can the following device be patented: A transmitting coil with a mica and a celluloid plate and a receiving coil with any insulating plate that will stand high temperatures are hooked up in such a way as to have the primary of the induction coil a constituent part of the transmitting coil circuit, while the secondary of the induction coil is in line with the receiving coil. Rays of light from the transmitting end strike the plate, which is silver-plated, thus affecting the electrical lines of force originating from the front part of the transmitting coil, which part forms the negative pole of this coil. These electrical lines of force produce an exact variation in the current flowing thru the transmitting coil and the receiving coil. These also affect the light rays emanating from the front plate of the receiving coil, which will produce the exact line motions and colors on the mirror at the receiving end, which is at a 45 degree angle. This image would be reflected in an inverted position. Therefore, a convex lens at twice the focal length will produce an upright image on the eye. The source of light is the same as the electrical current and the electrical lines of force. Both the transmitting and receiving coils are surrounded by an electrical field of force produced by the current flowing thru these coils. This current raises the fine wire back of the plates to incandescence, which wire is in the form of a helix so as to diffuse the light. When the wire is incandescent, the electrical lines of force are capable of varying or being varied by light rays, just as light rays can be varied by the colors of various objects. In other words, the vibrations are not physical, but energetical. The entire apparatus is in a vacuum so that the incandescent wire cannot oxidize."

A. We do not see upon what laws or what logic you based your reasoning, and even by stretching our imagination we fail to convince ourselves that your idea is even remotely possible.

New "Cold Light" for Movies

By EDWIN HAYNES

(*Continued from page 343*)

velopment and functioning of living organisms; and also the possibilities it offer for usefulness in therapeutics.

A better invasion of the microscopic world can be made than ever before. Insects so small and fragile that they would be instantly destroyed by the use of ordinary light can be held under observation indefinitely at the will of the operator.

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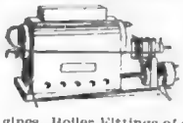

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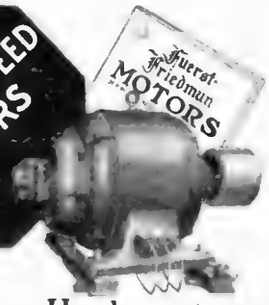

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Unlimited Destruction

(*Continued from page 390*)

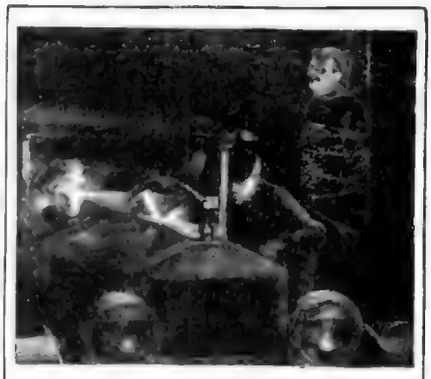
"Certainly. That was my plan from the beginning. The Great War ended, as you remember, in 1918. Instead of uniting in some plan to establish justice and abolish war, the nations quarreled over the spoils of the last one, nursed their ancient jealousies and race hatred with national pride and forthwith set about building larger and larger navies and maintaining huge land forces that could have no other effect than to increase the hatred and fear in the hearts of all against whom these armaments might be used. They outdid themselves perfecting implements of destruction—warships to go on the water, warships to go under the water and armored aircraft to pass over either land or sea. They devised poisonous gases and methods of spreading them so as to quickly wipe out entire communities. Nothing was left undone to make the next war inevitable and practically nothing was done to make it unnecessary. All conditions seemed to urge the world to repeat the folly of 1914. The League of Nations proved ineffective, Europe went bankrupt, millions starved for lack of food, sound governments were swept away by Bolshevism, commercial rivalry increased and race hatred became more intense.

"The end I saw clearly. The nations would again fight each other. Advanced methods of destruction would stage a war of unprecedented magnitude that would decimate the people of the earth. In poverty and dismay the survivors would destroy the governments that made such a colossal blunder possible and then, with the simplicity or stupidity of Russia, turn to Bolshevism or anarchy or some other quack remedy for their political and social ills. In other words, civilization would place itself on the chutes, shut its eyes and never pause until it reached the bottom, where in my judgment it would find itself back in a state of semi-barbarism. Another such war would put us back several thousand years.

"It seemed to me that we were developing the arts of war faster than we were developing the arts of justice and peace. We were learning how to kill each other faster than we were learning how to live together. We were getting scientific faster than we were getting civilized. The vast powers that nature and science placed at our disposal we were playing with, like children play with fire.

"I resolved to do what I could to prevent a war's recurrence at least in the near future. I felt sure it could be done if there were a way to destroy the major implements of warfare. At first it seemed impossible. Then I thought of the vast stores of energy concealed in the atoms of ordinary matter. If a means could be found of getting it there would be no question of power. I dedicated my life to its discovery. Professor Pingree you remember as a scientist who lost his life on an expedition to the Canadian Rockies. The whole thing was a ruse to fool the public and give myself a way to get away where the nature of my investigations could not be found out.

"I had a yacht fitted out with all sorts of instruments and books. Under an assumed name I had a laboratory built for me on Lonesome Rock—a solitary island far from the main routes of ocean traffic. For ten years I studied and experimented in seclusion. After many failures and few successes I discovered a means of producing rays of almost any desired wave length. Now, as you know, Dr. Stanton, an atom is made of a positive central nucleus around which circulate negative particles of electricity called electrons. In each element I found these rings revolve at a definite rate. By casting a ray of a certain wave length I



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found it possible to apply a force to the rings of electrons in any element that I chose. The rings acted upon by a force, then revolve faster and faster. The faster the particles move the more they tended to fly off from the positively charged nucleus, until at length a point is reached where their attraction for the nucleus can no longer hold them within the atom, whereupon they fly out into space at terrific speeds, forming the penetrating Beta rays. At the same time the nucleus, no longer influenced by the ring of negatively charged particles around it, becomes unstable and begins to disintegrate, throwing off ions of the gas Helium, or Alpha particles as they are called. Thus I found it possible to make any element disintegrate that I desired."

"But how could you possibly make that flying-boat on Lonesome Rock without help and without anyone knowing about it?" inquired Stanton.

"It was really very simple," replied Pingree. "All I had to do was to draw up designs and specifications for the various parts and have them sent to different factories in the United States. The parts were then shipped to Honolulu and to me under an assumed name. I then transferred them to Lonesome Rock and assembled them at leisure."

"Remarkable, indeed, Professor Pingree," observed the president, "but do you really fancy you are doing the public much good by destroying all the navies? What is to prevent wars on land?"

"Nothing unless the implements of land warfare are also destroyed."

"You intend to do this?"

"I do."

"But even then people can fight."

"To be sure, with battle axes and spears, but that kind of warfare does not produce the devastating results that cannon, gas and torpedoes do. In the days of the battle axe and spear men could fight for a hundred years without doing the destruction that modern methods can effect in a week. But now that I have explained my motives let me urge you to join in with me in my war against war. I have already succeeded in temporarily stopping a world war by destroying the navies. I can easily proceed to destroy all the major implements for land warfare, such as artillery, tanks, etc. If the world can be persuaded to cooperate with me this can be accomplished much more gracefully and pleasantly than otherwise. It is for your cooperation and support that I have come here to appeal."

"But if we grant that war can be prevented by complete and radical disarmament how is this going to establish justice and remove the cause of war?" asked the president, unwilling to be convinced.

"It will accomplish it indirectly, but not directly," answered the professor. "War itself never establishes justice and the fear of war seldom does either. War determines only which side is the strongest and most strategic, or in some cases the most brutal. If the principal means of warfare are pretty generally destroyed the world is going to get a breathing spell in which it can get over the effects of the last war and possibly find other means of settling disputes that will come into more favor."

"But when you remove all means of war you expose the world to piracy and brigandage, Professor Pingree," again objected the president.

"I have thought of that possibility, too, Mr. President, and have purposely left a number of small cruisers to each nation for that possibility. The destruction of land armaments need not be entirely complete either for a similar reason, but as you will admit we need no such armaments as we now possess for internal defense alone."

"I believe you are right, Professor Pingree," said the president after a long silence, and shaking his hand heartily he added: "At all events, I shall do my best to make your

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moves more popular. Now that all the other navies are gone I'm sure the country won't object to letting ours go, too. Then with the marine forces gone it will be relatively easy to get all nations to undergo substantial reductions in land armaments and forces as well. The world can then settle down to a period of peace and enjoy the wonderful benefits which your discoveries will yield. We shall all be able to fly about as you do in high speed planes, operated by interatomic energy. We shall derive our fuel for our homes and factories from the common earth or the unlimited atmosphere."

"I'm not so sure about that," answered Professor Pingree slowly. "As soon as this disarmament proposition is over I shall destroy my flier and all instruments used in liberating and controlling interatomic energy and my lips shall be sealed forever concerning the methods employed."

"But why, Professor Pingree?"

"Because the world at present is far from being civilized sufficiently to use such stores of energy without much abuse of it. No life can feel safe while anyone possesses this power—the power of *unlimited destruction*."

Fish That Walk

By DR. ERNEST BADE

Continued from page 335

most imperceptible movement of the tail, helps its onward progress. It is a comparatively slow advancement, but in a few minutes it can cover quite a little ground. These rays or fingers have another purpose as well, in that they enable the gurnard to find food hidden in the sand.

The gurnards do not leave the water; taken out of their natural element they are just as helpless as the Australian *ceratodus*. The paired fins of the latter are comparatively large, spear shaped, and show a well developed skeleton. Two species (*Ceratodus fosteri* and *C. microlepsis*) are known, which inhabit the so-called water holes of the river beds rich in vegetation. In these places some water can always be found even in the driest of seasons. The air-breathing lung of these fish consists of cells, and this organ is in constant use, together with the gills, so that the animal can exist in polluted waters fatal to all other fish.

The paired fins of this creature cannot be used on the land as they are far too soft. On the bottom of the water hole these animals use them to crawl about. Here they are able to support the body and keep it slightly elevated.

These fish are sluggish and their entire mode of life resembles that of newts and salamanders.

The paired fins—the pectoral and ventral fins—are but slightly used while swimming through the water. They are primarily employed for steering, for giving the body a rising or falling inclination, and in some cases for a slow backward movement. In general they aid the fish in that they keep it in equilibrium. Therefore it was a simple matter for those fish inhabiting the bottom to employ these fins, and after a time they are supposed to have developed into leg-like structures. But upon the land these structures could only be used after the fish had adapted itself, at least partially, for breathing air, as is the case with the mud-skipper.

The lung-breathing Australian *ceratodus* has not advanced to this extent. It is not able to walk on the land in spite of its fin development. It, as well as its relatives, still stand below the larval stage of newts and salamanders. Just as the latter have externally branched gills, so have the larvae of these fish when they hatch from the egg. In this way the development of both are related, but the organization of the fish *ceratodus* is lower, although both originated from a common branch.

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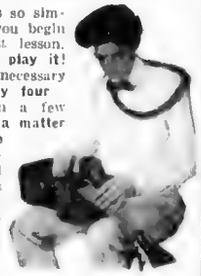

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How I Hypnotize Animals

By C. SCHMITT

(*Continued from page 324*)

spite of its uncomfortable attitude, true sleep apparently followed.

The experiment with the rooster succeeded very easily. Altho it resisted violently so that its legs had to be drawn down with considerable force, and its head held down upon the table, it soon relaxed. The wings sank down slowly, and the eyes remained open. The fowl could not be recalled to life by whis.ling, shouting or other noises, altho it instantly responded to a light puff of air, whereupon it returned to its family with a tottering pace.

The French naturalist, Fabre, tells of one of his boyhood tricks: "In the vicinity of our residence there was a flock of turkeys on the common. When they were unguarded, we had our fun with them. Each of us would seize a turkey, place its head under the wing, rock the animal back and forth, and then place it on the ground. In this way the whole flock would be put to sleep by us so that the ground looked like a battle-field filled with 'dead and dying.'"

There was no turkey at hand, but I still wanted to try Fabre's boyish trick. So a struggling duck was taken. Not without great difficulty was the head finally placed under the wing. Then it was rocked back and forth—but in vain. It remained as full of life and vigor and protest as in the beginning, and the experiment had to be given up.

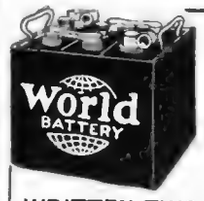
Better results were obtained with the European lizard *Lacerta agilis*, and with our own *Anolis Carolinensis*, the so-called *chameleon*. Male and female were used. The male was placed in the open hand, and with a sudden movement of the other hand it was placed on its back and held for a second in this position. It remained motionless, altho immediately before it had made violent attempts to escape. The experiment was just as successful with the female; in fact she remained for seven and a half minutes in the hypnotic state.

It would appear to be self-evident that what would succeed so well with the active lizard would certainly work well with the sluggish salamander. But it took much time and many photographic plates before a good negative was obtained. Taking the animal out of the hand and placing it upon the table each time recalled the weakly hypnotized animal to life. A large piece of paper was finally placed upon the back of the animal and the whole quickly turned over. In this way the hypnotized creature was successfully placed upon the table where it remained for more than five minutes.

A frog is just as easily hypnotized as a rooster. It is held between the two hands just as is the case with the lizard. Then he was turned over suddenly. Then he can be held by both hind legs, and the animal is quickly raised and lowered a few times. The muscles relax immediately and the legs of the creature can be given almost any position desired. When the exposure was made, a blue-bottle fly alighted on the tip of the nose of its deadly enemy. But the frog never snapped at it, altho his eyes were open during the whole period of hypnotization. The skin seemed insensitive to all mechanical stimuli and yet the animal could not stand being blown upon. The slightest puff of air brought it back to life.

A timid raven with a lame wing acted quite differently when hypnotized. It remained perfectly quiet when placed on its back, altho it kept watch on all that happened in its vicinity. It even pecked at a finger held in front of it so hard that it could be lifted from the table. There seemed to be no paralysis of the muscles.

The bird was lifted by one of its toes from the table and hung to a wire, head down.



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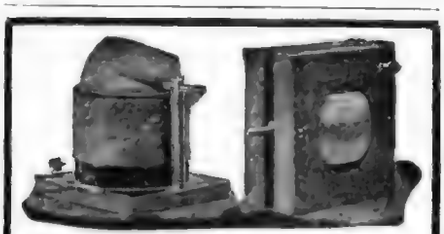

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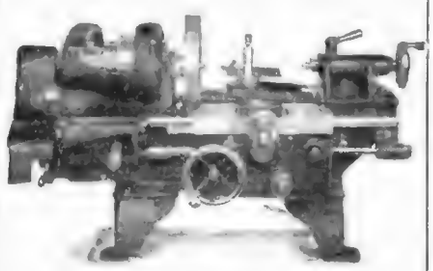

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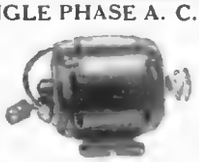

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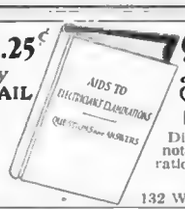

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The wings slowly sank lower and lower, and it remained in this position for seventy-five minutes. But as soon as it was lifted, it escaped, fluttered about, and could only be caught after quite a long chase.

Fresh-water crabs were most amusing when hypnotized. They were taken out of the water and placed on their heads. After gently stroking their back from tail to thorax, the muscles of the claws relaxed. Then a triangle was made with head and claws which kept the creature in equilibrium, for this is the essential thing. Whenever the animal fell over it invariably awakened. Later it was possible to hypnotize them by simply holding them in position until they accepted the inevitable.

A large stag beetle was dropped from a slight height upon the table. It fell on its back and stretched its legs upward. In this position it remained quietly for some minutes. When the table was shaken, life first showed itself in the hind legs, which was soon followed by an attempt to right itself.

Years ago I kept a living specimen of the insect called walking stick (*Dixippus morosus*). They have the characteristic of rocking on their long legs when disturbed. When frightened they drop off the leaf and remain hanging on its edge, by front or hind feet, and so almost completely disappear from view. When they are stretched and the legs lie in line with their body, they resemble a twig rather than a living thing. In this condition, which is very pronounced when the creature was dropped upon the table, it became stiff and rigid. For hours it often remained in this position, and even allowed itself to be put into the strangest positions. Once I placed one of these creatures between two match boxes so that they rested on it with only their legs, or with the extreme tips of the body. An hour later the insect was still in position, but a slight blow upon the table was sufficient to recall the creature to life.

Not with all animals of the same species does the experiment succeed. There seems to be more or less disposition toward getting into the hynotic state.

The experiment with the duck was a failure, altho the hypnotic state is said to be much easier to get in the duck than in the pigeon. The same is true of the frog and yet one of them struggled so much and so hard that I was compelled to set it free. It hardly remained one second on its back.

Perhaps it is nothing more than a certain kind of hypnosis when the snake fascinates the frog and holds it spellbound, or when a sheep offers no resistance to a butcher, or when a horse, on being loaded on a ship, stands motionless as it is being lifted into the air.—(From *Kosmos*.)

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Spectacular Stage Tricks

By H. WINFIELD SECOR

(Continued from page 337)

employed in staging this scene. The scene itself represented the inside of a large gun turret at a fort. A small (it looked big) charge of powder was placed in the breech of the gun and it was then trained on the target with all due ceremony and effect, as created by the actors; the electric button was pushed and with a tremendous BOOM! the gun exploded, killing all but the hero, of course.

THE BURNING LOG CABIN SCENE

The third picture shows a burning log cabin scene and how it was produced. Needless to say, where actual flames are used on the stage, which is seldom nowadays, the scenery must be thoroughly fire-proofed and as much non-combustible material used as possible, such as asbestos, metal, etc. The logs of which the cabin in the scene here shown was produced were formed of metal and painted so as to thoroughly resemble real logs viewed a short distance away. Rags soaked in gasoline or other volatile fluid were placed in the crevices between the logs and the different layers of rags connected by vertical ones, so that when a match was touched to the lowermost row it was but a few moments before the whole wall was ablaze. The roof was made of metal and asbestos.

The villain sets fire to the miner's cabin in this play, and the hero of the day arrives as the cabin is burning, runs down one of the water chutes as here shown and leaps off the end of it to the ground. As a matter of fact, the heroine, for it was a lady who saved the day, did not land on the hard stage floor, but instead on a rubber mat suspended a few feet above the floor in the manner shown, its construction being similar to those used by acrobats in the bounding billiard table acts.

A DROWNING SCENE ON THE STAGE

The fourth stage scene here illustrated represents that produced in one of the melodramas popular a few years ago. In this scene a rubber apron covers the entire stage so that water to a depth of one foot or a little more is obtainable about the stage, to permit a flat-bottom boat to float upon it carrying a person or two. In the center of the stage a representation of a rock was placed, underneath which was a shelf just above the level of the water. Just back of the rock there was a deep *diving pocket* formed, nine or ten feet deep.

The heroine and the villain are seen rowing along near the rock when the villain suddenly becomes angry because the fair lady will not comply with his wishes, snatches the child out of her arms and throws it into the water. He actually throws a weighted dummy in the water. As the boat glides along behind the rock, the woman, unseen by the audience of course, adroitly places the living child on the shelf under the rock. The various actions take place close together, as regards the successive events, and also in a dim light, all of which help to run the scene off smoothly. In a few moments the hero appears in another boat, and learning from the woman's lips what has happened, he mounts the rock and dives into the ten-foot tank of water. The audience is breathless! In a few moments the brave hero comes up out of the water just behind the rock and he has saved the child. How he did it is simply explained.

As he rises out of the water behind the rock he grasps the living baby from under the rock, taking care that the clothes get a little wet, this not being absolutely necessary, however, and clambers up on top with the child.

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Forgery-Proof Checks

By BURGESS SMITH

(*Continued from page 321*)

This machine is the invention of the writer. Its chief function is to compensate automatically for the fluctuation in the light projected from the machine's six-barred lamp. The light would fluctuate with the fluctuation of the voltage from the lighting system and thereby vary the intensity of the design were it not for this timing device. To eliminate this variation the timing machine is driven by a motor from the same current that furnishes the light for the big machine's lamp. When, for instance, the light varies in density the motor varies correspondingly in speed. The shutter on the machine's lens is also operated from the timer by compressed air furnished through a tube. The shutter is automatically closed through this air pressure.

The operator sets the gauges of the camera according to mathematical formulas worked out in advance, and the machine is then ready for action. As he pushes on a pedal there begins an intermittent but regular clicking sound, and at the same time a tiny point of greenish light glows at a spot down in one corner of the glass. And thus, step by step, as the gauge is regulated, the little cluster of dots is photographed in a solid unbroken horizontal line across the surface of the sensitized plate.

The next step is to get the tiny dots photographed in a uniform pattern over the entire surface of the plate. This requires the use of another large and costly machine, which, like the timing machine, was invented by the writer. This machine has a horizontal bed, seven feet in length and three feet wide, and is mounted on a ball-bearing, three-point support imbedded in masonry, for here again there must be no vibration.

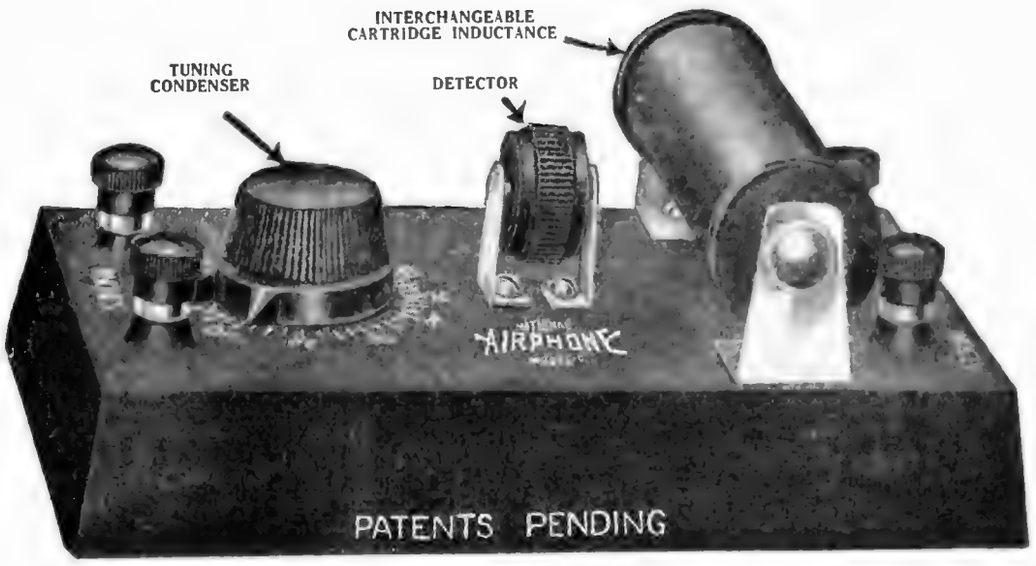
Cut out of the bed of the machine is a mirror six inches in width and all the way across. Light evenly distributed from a powerful lamp container is reflected upward through this mirror, over which is placed one of the sensitized celluloid films. Then the entire bed is covered with a sheet of film, which is firmly clamped to a traveling carriage.

Through powerful cams a rubber-covered pressure pad squeezes the celluloid film into contact with the negative of the line of dot clusters. But this alone is not sufficient to secure even pressure, so compressed air is blown into the rubber pad until perfect optical contact is assured. The inflation and deflation of this pad is automatic and is done in a twinkling.

Now the machine is all set to transfer the line of dots on the plate to the celluloid film. But they are not only capable of being transferred, for by a "step and repeat" process, governed by an accurately gauged micrometer, they may be photographed in a solid unbroken pattern over the entire surface of the film. As the film is gradually moved or "stepped" across the illuminated mirror the image of the sensitized plate is repeatedly transferred to it. If the formulas have been properly followed and the gauges of the machine accurately set, then the dots should present a solid pattern, with no line of demarcation to show where they were joined, even when studied under a powerful microscope.

The second plate is put through the same process, and then the two films are taken out of the dark room and placed one over the other on an illuminated ground glass. One is moved slightly with relation to its mate. If there has been the slightest error in the long series of mathematical calculations governing the draftsman's original drawing of the two sets of circles, or of the formula

(*Continued on page 402*)



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8. Variable Mica Condenser used is acme of simplicity—high capacity, impossible to short-circuit

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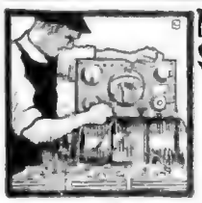

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Complete Crystal Receiving Sets

1 pair Dreyfuss 'phones
100 ft. aerial wire
2 insulators
1 ground clamp

PRICE $14.00

P. M DREYFUSS

152 Chambers St., New York City

Forgery-Proof Checks

(*Continued from page 400*)

used in the "stop and repeat" machines, the result is a total failure.

But if everything has worked out according to prescription, then an amusing thing happens. With the first slight movement as one plate is slid over the other all those thousands of tiny white dots seem to spring into life. Every imaginable geometric figure appears. They resolve themselves into groups, clusters, stars, circles, squares, diamonds, dazzling frost crystals and an infinite number of other arrangements, all interwoven into the most intricately beautiful patterns. Even a slight movement of the eye or shift of the plate brings a different pattern into view. In the course of moving one 12-inch plate from edge to edge over its twin plate, literally thousands of new designs spring into view as if by magic, and instantly dissolve into others infinitely different.

Frosty crystals become twinkling stars or circles or squares; the squares reform themselves into diamonds and the next instant into a new arrangement of circles again.

While in the act of moving these superimposed plates a pattern of particular beauty suitable for a check design may disclose itself at any instant. And in that fleeting moment it is possible to "freeze" that pattern and preserve it by clamping the two plates together.

Now before they can be printed the two separate images on the glass plates must be reproduced separately on two metal plates without losing the exact relative positions of the two sets of dots. To do this the two film plates are carefully bolted into another type of "repeat" machine having a horizontal bed, and by another complicated photographic process the two images are reproduced on zinc plates.

A vacuum contact camera is used in this instance. The two films and the zinc plates to which their images are to be transferred are drawn firmly together between the glass plate forming the bed and a rubber covering. A vacuum pump sucks up the air between the two coverings until the rubber is drawn taut across the plates, the pressure being evenly distributed. The camera is then set up vertically and a powerful light plays continuously on it for a few seconds. When the plates are removed it is found that the two separate images have been transferred to the zinc plates. These plates are then etched lightly in an acid bath, and again there spring into view the thousands of white dots, in the exact position they were when first reduced from the draftsman's circles.

All is then ready for the lithographic press. The word "VOID" in dot formation is first printed on the surface of the check, after which it receives in turn but without special order the impressions from the two zinc plates. The three prints blend in a beautiful pattern. The three plates are printed in three different kinds and colors of inks, each having a certain chemical property of its own.

Thus we have a pattern which can never again be produced except by the use of the original formulas for the dot clusters and the particular order in which they were repeated, combined with the one chance in several thousands of again bringing them together in that exact superimposed relation. The possibility that an outsider might stumble upon this combination is even more remote than the possibility of two persons being found with identical finger prints.

Finally on the back of this safety paper a new dot pattern is printed and so arranged as to afford security for the endorsements.

Ask to See This New Radio "B" Battery

Ask also to see the Willard All-Rubber Radio "A" Battery—a 6-volt battery built especially for Radio reception.

Ask your dealer or your nearest Willard Service Station to show you this specially designed 24-volt rechargeable Radio "B" Battery. Note the leak-proof glass jars—hard rubber screw-on covers—special Radio "B" plates—Threaded Rubber Insulation.

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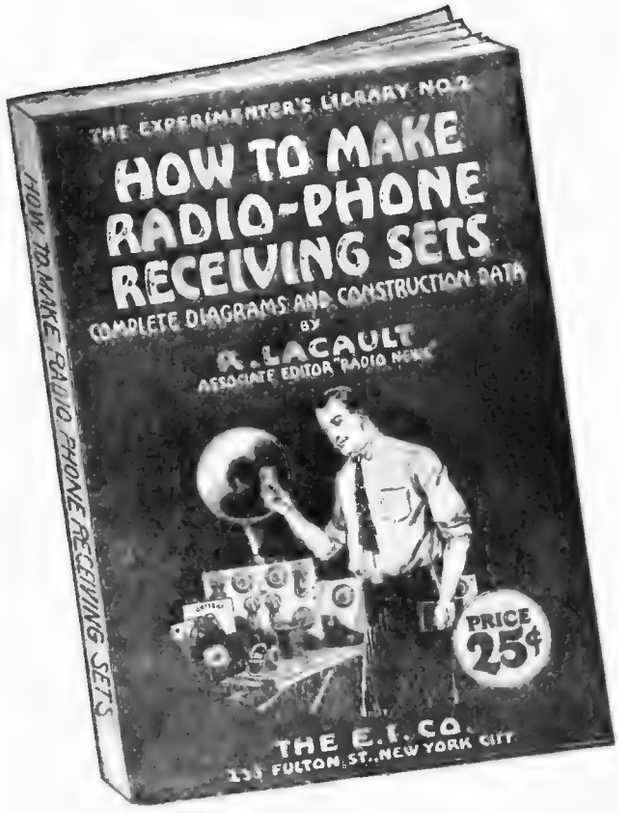
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PRICE 25¢
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HOW TO MAKE A RADIO-PHONE RECEIVING SET

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A NON-TECHNICAL book for the beginner. Gives complete constructional data on the building of a complete Crystal Detector Set, Tuning Coil, Loose Coupler and a Single Audion Tube Set with Amplifying Units. It furnishes all dimensions and working drawings of every part that must be constructed by the amateur. Written in plain, simple language that anyone can understand. The opening chapter gives a complete description of the theory of radio and tells what it's all about, teaching the principles of wireless so that the constructor knows what he is doing.

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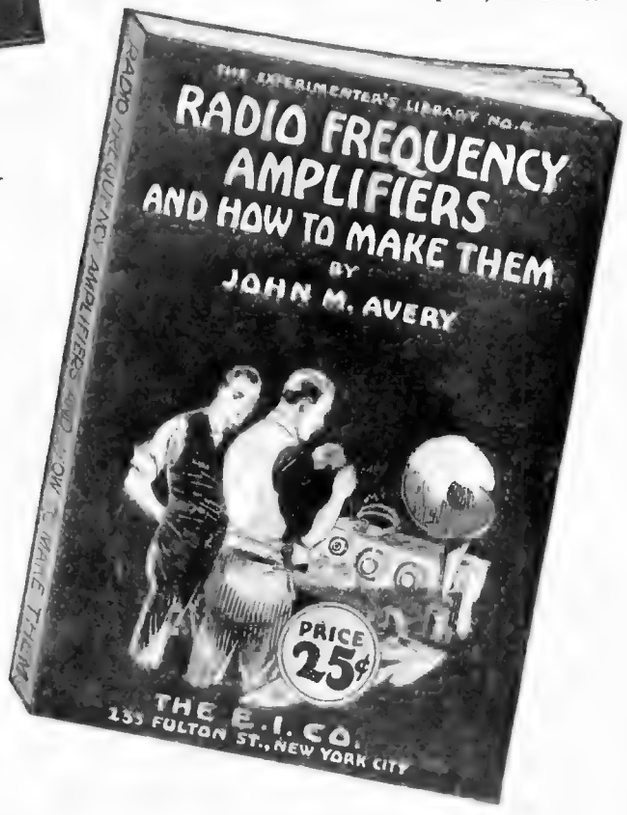
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THIS book is for the more advanced amateur, showing the construction of the Radio Frequency Amplifying Transformer and giving complete constructional data. It shows the application of Radio Frequency to amplifying units that the amateur may already possess and gives 15 hook-ups showing practically every use Radio Frequency Amplifying Transformers can be put to.

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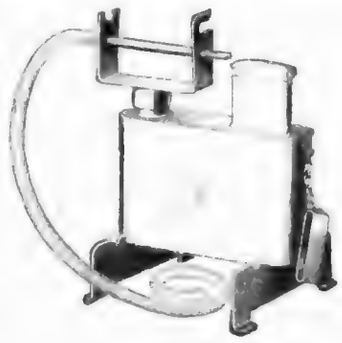

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$3.00 buys the entire outfit

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National Radio Institute, Dept. 1194, Washington, D. C.

Cold Light

By DR. ERNEST BADE

(*Continued from page 326*)

which he added a solution of *luciferase* With the aid of a delicate galvanometer he was able to find that the average rise in temperature was less than 0.001 degree C., so that it presented indeed to all intents and purposes the phenomenon of a cold light. But at the present it is a laboratory toy, purely scientific in character and of no practical use.

It is not at all necessary to be restricted to this Japanese *crustacea*, many luminous forms are found in our own waters. In fact, the most beautiful green light is produced by *Noctiluca miliaris*, which can be found by the million. Every wave crest seems to be covered with a glittering diadem and the slightest stimulation causes a brilliant emission of light. But this is not a continuous phosphorescence, and it is not of uniform brightness. Tiny spots or dots are sharply defined, as the creatures flash on and off. And if one should cast a net into this fiery sea it will be brought up like a molten mass of incandescence from which innumerable sparks are discharged. Here the *luciferin*, formed during the period of rest, is used up again as light is produced.

Restricted and localized light organs are also common, although they do not occur in any overwhelming numbers. The best known example is that of the firefly, an insect found in all our fields and meadows in the summer. On dark nights the flashes of myriads of these beetles is indescribable and lend a peculiar charm to the landscape. These fireflies are nocturnal, being only noticeable in dusk and darkness; in the daytime they are hidden in the foliage of herbs and grasses.

The organ of light is here restricted to two or three segments, according to the species, which are situated at or almost at the extreme tip of the under side of the abdomen. The flash is bright and continues from one to a few seconds, while the intervals are much longer. Curiously enough, the eggs are luminous and glow with a steady light; even the larva do this, although the organ is here quite distinct from the rest of the body.

The light from the firefly shines through transparent membrane, the rest of the body being provided with dark, pigmented chitin, which is impervious to these rays. The organ itself is situated just above the transparent section and is divisible into two parts, a reflector layer several cells in thickness and a photogenetic layer of large cells. Trachids lead into this organ and supply the necessary oxygen for the correct functioning of the light.

The practical use, which the animals derive from their own light, is, in some cases, still problematical. It is possible that some forms may light their surroundings to secure food. Others, especially those that glow when stimulated, probably employ it as a weapon of defense to frighten away their enemies. Still others, and this is true of the glow worms and fireflies, use this phosphorescence not only to distinguish the sexes, but also to seek their mates.

The efficiency of the fireflies light, considering the amount of energy expended, is 96%, that of a tungsten lamp 1.3%, while that of a petroleum lamp is 0.04%, but the tungsten or petroleum lamp is to be preferred. Their light is more fully white. The former has sacrificed its spectral range for efficiency. And if every such a light were produced in sufficient intensity, it would still be objectionable, as color values would vanish and practically everything would be of a uniform green hue.

"Stop those back fence concerts"

THE yowls of a prowling Tommy are as mere love-songs beside the ear-splitting howls of a perturbed radio set (and you'll be surprised how often one gets perturbed without the calming influence of the proper Amplifying Transformer).

Most any transformer can amplify sound, but it will also amplify the stray fields which produce howling and distortion. It takes the Acme Amplifying Transformer with its specially constructed iron core and coil to put an end to the "back-fence" concerts. Only when you add the Acme do you get the realistic tone and volume so markedly absent in the ordinary radio receiving set.

The Acme Radio Frequency Transformer greatly increases the range of any receiving set, either vacuum tube or crystal detector type. The Acme Audio Frequency Transformer produces not only volume, but reality of tone. It is indispensable to the satisfactory operation of loud speaking devices. The combination of one or more stages of Acme Radio and Audio Frequency Transformers assures the maximum of range, of volume and of reality in tone.

The Acme Apparatus Company, pioneer radio engineers and manufacturers, have perfected not only Radio and Audio Frequency Transformers as well as other receiver units and sets, but are recognized as the foremost manufacturer of Transmitting Apparatus for amateur purposes. Sold only at the best radio stores. The Acme Apparatus Company, Cambridge, Mass., U. S. A. New York Sales Office, 1270 Broadway.

Type A-2 Acme Amplifying Transformer
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Guards Your Radio Like a Sentinel, Day and Night

Every lightning flash fills the air with static which has potential dangers to radio and home unless they are protected by the BRACH Vacuum Lightning Arrester. This unfailing sentinel requires no attention—it is on the job all the time, does not have to be switched and cannot become grounded. The action is like that of a safety valve in a steam system.

The Brach Arrester is made in two types. Type 200 used either indoors or outdoors if housed. Type 223 for outdoor service only.

Both types are built up to a standard, not down to a price

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16 Years Specialists in Lightning Protective Apparatus

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Which is a Full Wave Automatic Magnetic Rectifier for 105-125 Volt 60 Cycle A. C. Leave Battery in Car. Screw Plug in Socket; Snap Booster Clips on Battery Terminals. Turn Switch, lock garage door, knowing Your Battery will be Charged in the Morning. Is It Not Gratifying to Feel Your Batteries are Ready for All Radiophone Music & News? Starting Car Quick, requires Fewer New Batteries. Booster thus Saves more than its Cost. A Complete Compact Self Contained Conveniently Portable Automatic Charging Unit. Adjustable Renewable Infusible Carbon Electrodes Rectify Current Uninterruptedly. **AMMETER** eliminates All Guess Work. No Skill is Required. They last a Lifetime. Don't think Your Battery is dead & worn out simply because it will not start Your Car. **Buy a Booster & Fill It With Life. It Saves You 75c a Charge. REDUCED PRICES**

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Marconi Explains Directional Radio

By A. P. PECK

(*Continued from page* 356)

These tests were being carried on over a distance of 95 miles, with only 700 watts supplied to the antenna.

With both reflectors down and out of use, speech was only just audible with no shunt at all. Average measurements indicated that the value of the energy received when both reflectors were used was about 200 times that of the energy received without any reflectors.

By means of suitable electron tubes it is now possible, and entirely practicable, to produce waves from about 12 meters and upward in length, utilizing a power of several kilowatts. This power is obtained by connecting several tubes in parallel.

Reflectors, besides giving directional working, show another unexpected advantage, which has been found to be common to all sharply directional systems. This is, that practically no distortion of speech takes place, such as is often noticed with non-directional transmitters and receivers. From all these tests we gather that radio waves 15 to 20 meters in length are quite practicable, and provide good and reliable point to point directional transmission over fairly long ranges.

Marconi found that the results obtained by reflectors were so good that he tried out his old idea of 26 years ago, which was to use the directional transmitter and receiver as a position finder for ships near dangerous points. An idea of how this would work may be gathered from the accompanying illustration, which shows a directional transmitter mounted on a revolving table; this is set up on an elevated truss-work on a dangerous rock near the sea. Ships coming near this revolving transmitter will be able to receive signals at certain intervals. The transmitter is arranged to make one full revolution in two minutes, and by means of a clock-work arrangement a distinctive letter is sent out on every two points of the compass and short signs, such as the letters I and T, mark the intermediate points and half points. Now, as this reflector revolves, the signal will be sent out in all directions similar to the beam from a revolving lighthouse lantern, with the exception, of course, that the ship will be notified of the proximity of the rocks by radio instead of by vision.

It has been found that a steamer is enabled in this way to get the bearing of the lighthouse within one-quarter of a point, or within 2.8 degrees circular measurement. Dr. Marconi gave a demonstration of how the transmitter and receiver worked. As may be seen from the accompanying illustration, the transmitter consists of a single vacuum tube and three inductance coils connected to a vertical antenna about 1 foot long, which is placed in the center of the focus of the transmitting reflector. The signals are controlled by means of a regulation key. The receiver consists of a carborundum detector and a fixed and variable condenser, inductively coupled to the receiving antenna, which antenna is of the same size as that of the transmitter. The circuit used in the experiments was the conventional crystal receiving circuit, with the exception that a vacuum tube power amplifier was used to increase the strength of signals.

By having an assistant send test signals with the key, Marconi showed, by swinging the reflector from side to side, how the received signals faded and gained in strength according to the direction in which the transmitting reflector was pointed. He then showed how these signals could be interrupted, or rather absorbed, by placing a wire having the same wave length as the receiving

(*Continued on page* 409)

WONDERFUL NEW INVENTION BRINGS RADIO RECEPTION OVER YOUR ELECTRIC LIGHT WIRES

Super-Antenna

THIS wonderful unit has been developed by the country's foremost engineers, making possible radio vacuum tube reception over your electric lighting circuits. No power current is used when operating a "Super-Antenna." It operates on any electrical circuit from 32 to 120 volts, D.C. or A.C. Light plug can be turned either "ON" or "OFF."

The "Super-Antenna" is shock proof, will not blow fuses, and will not damage a receiving set in any way. During the many months of development of this unit, all practical circuits were protected. Beware of imitations. They are expensive to experiment with.

No Outside Aerial Necessary

This unit does away with the dangers of stringing antenna over power and lighting wires, where great danger results when antenna touches live wires caused by storms, etc. The "Super-Antenna" eliminates all troubles and dangers incident to the erection of the antenna. Most convenient for using your vacuum tube receiving set anywhere. You just insert plug in any electric light socket and connect binding post to your receiving set.

TESTED BY LARGEST EXPERIMENTAL STATIONS

The "Super-Antenna" has been tested by many Radio Experimental Stations and found to give marvelous results. Stations twelve hundred miles distant may be readily copied with the ordinary installation, and in the majority of circuits it tends to reduce static effects.

Safe--Efficient --Convenient

NO POWER CURRENT NECESSARY
ELIMINATES DANGERS
SHOCK PROOF
WILL NOT DAMAGE RECEIVING SET
WILL NOT BLOW FUSES

ORDER TODAY $2.80

The demand for this "Super-Antenna" is taxing our supply to the limit, so get your order in early. Dealers everywhere are stocking them. If your Radio Dealer cannot supply you with the "Super-Antenna" order direct and send us his name.

Enclose Check or Money Order. West of Rockies $3.00, Canada $3.70.

Dealers and Jobbers Be first in your territory to stock this wonderful unit.

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MOST SENSITIVE!

Better Than a Regenerative Set

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With Seven Two-Color Radio Maps

280 pages (88 pages more than the 3rd edition), better paper, stiff covers, etc.

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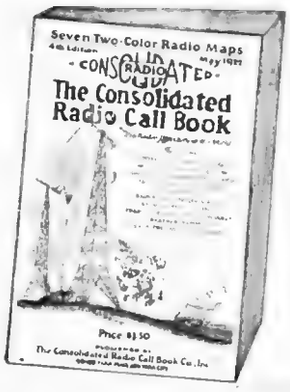

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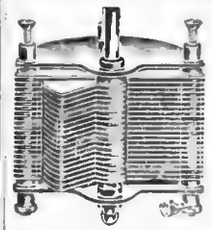

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Marconi Explains Directional Radio

(*Continued from page 406*)

antenna directly in front of the latter and between it and the transmitting antenna. However, if this wire were of shorter or longer length than the receiving antenna, no effect was experienced.

Another aid to navigation may also be brought about in the following manner: During some of his tests the Senatore noted the effects of reflection and deflection of radio waves by metallic objects miles away. From this he decided that it should be possible to design apparatus by means of which a ship could radiate or project a divergent beam of these rays in any desired direction, which rays, if impinging upon a metallic object such as another steamer or ship, would be reflected back to a receiver, screened from the local transmitter on the sending ship, and thereby would immediately reveal the presence and bearing of the other ship in fog or thick weather, even though the latter were not equipped with radio. A conception of this idea is shown in the accompanying view.

Marconi has also attacked another problem, which is a bug-bear to the amateur as well as to the professional operator today. This is the elimination or reduction of *static*. His latest method is as follows: CW (continuous wave) signals are induced in the antenna from certain measuring apparatus, which signals are made equal to those received from the distant transmitting station. By means of this special measuring apparatus, the voltage applied to the antenna can be directly read off. An aerial of standard size is used for the apparatus, and from the above-mentioned readings the strength of signals in microvolts per meter can be readily calculated. Now, if the signals are unreadable because of heavy static, the measuring apparatus is used to send to the operator at the distant transmitting station at a standard rate of speed, and the voltage applied to the aerial at the local sender is increased until complete readability is obtained, at which time the distant transmitting station signals to this effect. The ratio of the new voltage applied to the antenna, to that of the old voltage (equal to that of the signals received at first), gives at once a very correct estimate of how much the power of the transmitting station would have to be increased in order to insure readability. In other words, static is partially overcome by sheer power.

Marconi has visited this country on board his yacht, the Elettra, which is fully equipped as a floating radio laboratory. On board the yacht, Marconi does practically all of his experimental work, moving from place to place, testing static, audibility and other factors which enter into radio communication, in many different parts of the earth and under all sorts of conditions.

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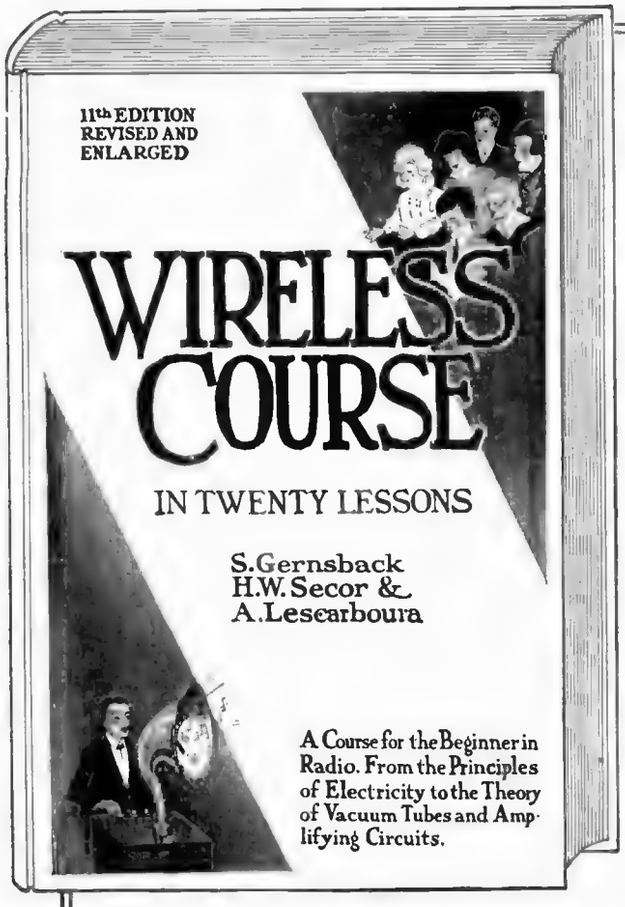

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Radio-Telephone and Aircraft

By S. R. WINTERS

(*Continued from page 357*)

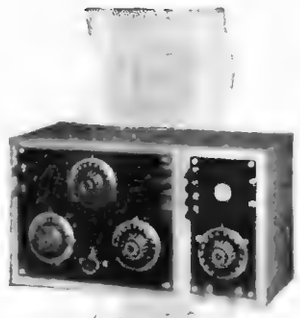
proved to be ineffectual in accomplishing the desired results. The two horizontal coils, operating at a wave-length of 1,000 meters, apparently have the capacity of localizing radio-telephone or radio-telegraph signals, and thus determine the direction and location of landing fields when fogs and other conditions of obscurity intervene.

The expanding application of radio-communication to *mechanical birds of flight* is suggested by recent innovations of employing this agency as a means of revealing to the pilot the exact height he is soaring above the earth. Two methods are involved in the introduction of this novel system: First, capitalize the noise reverberating from the aircraft engine by picking it up on the ground in a series of micro-phones, thus indicating the altitude of the machine. The figure would then be transmitted to the pilot by the use of a radio-telephone located on the ground. The second method suggested for determining the altitude of aircraft involves the employment of a device which would capitalize the principle that when electrical oscillations are maintained in a circuit the frequency of these electrical disturbances is dependent upon the capacity and inductance of the electric circuit.

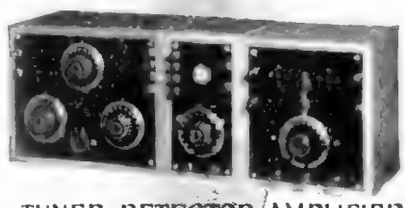
And, while broaching the subject of noise from aircraft engines, it may be said that these mechanical difficulties are being gradually overcome in the formation of a "close corporation," figuratively, between "artificial birds of flight" and radio-telephony. Obviously, wireless receiving apparatus is extremely sensitive to extraneous disturbances and vibrations. Noise is partially overcome by specially-designed head-telephones for aviators, this head equipment largely eliminating vibrations foreign to the reception of communications by the wireless route. Likewise, an intricate system of retardation coils and condensers, an adjunct of a filtering device, eliminates to a considerable degree noises produced by the aircraft engine and transmitting radio-telephones.

A radio-telephone set designed by the Signal Corps of the United States Army for use on aircraft enables the observer and pilot to be in constant communication with each other, as illustrated in one of the photographs herewith. It bears the label of interphone set type SCR (meaning Signal Corps Radio) type 57-A. The use of a four-pole double-throw electric switch, when closed to the right in the *Interphone* position, renders it possible for the pilot and observer to be altogether disconnected from the radio-telephone outfit proper. Automatically, as it were, they are in immediate intercourse with each other by use of a conventional telephone circuit. Conversation may be negotiated between the two in the absence of additional manipulation of any mechanism. A redeeming virtue of this aircraft interphone equipment is a so-called *side-tone* circuit, comprising a condenser, the function of which is to shunt or sidetrack some of the telephone current from the transmitter circuit back into the telephone receiver circuit of the person talking. This arrangement serves the purpose of disclosing to the operator the volume of his own voice and indicate whether the circuit is functioning properly. In the absence of this provision, the aviator would be denied the privilege of listening to his own voice by reason of the sound-proof helmet which he wears.

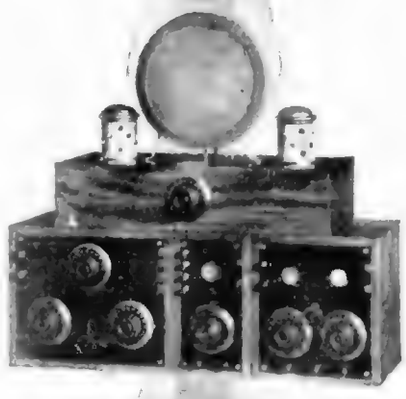
When the electric switch is closed to the left at the position labeled *Radio*, the telephone receivers of the observer are directly connected to the wireless-receiving circuit. At the same time his telephone transmitter is directly connected to the transmitter terminals at the radio-set box.



TUNER-DETECTOR



TUNER-DETECTOR-AMPLIFIER



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Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Missouri.

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Write the Words for a Song. We compose music. Submit your poems to us at once. New York Melody Corp., Fitzgerald Bldg., New York.

Song Poems Wanted. Submit manuscript to New Era Music Co., 1176St. Louis, Mo.

Wonderful proposition for song, poem or melody writers. Ray Hibbeler, D115, 4040 Dickens Ave., Chicago.

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Make $19 a Hundred stamping names on keychecks. Send 25c. for sample and particulars. Ex Kaytag Co., Cohoes, N. Y.

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Old Coins, Novelties, etc. Write for circulars. George R. Weller, Mount Pulaski, Illinois.

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Stamps—20 Unused, all Different. Free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

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Telegraphy (Morse and wireless) and railway accounting taught thoroughly. Big salaries. Great opportunities. Oldest, largest school. All expenses low—can earn large part. Catalogue free. Dodge's Institute, O St., Valparaiso, Indiana.

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Ventriloquism taught almost anyone at home. Small cost. Send 2c. stamp today for particulars and proof. Geo. W. Smith, M 92, 125 N. Jefferson, Peoria, Ill.

Wanted to Buy

Full value paid for old gold jewelry, watches, diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore, magneto points, war savings stamps, old false teeth. Packages held 4 to 12 days and returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable), 120 So. State St., Dept. 73, Chicago, Ill

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World War Relics collected from Europe's battlefields. Catalogue 10c. Photos, actual warfare, 275 diff., $5. Sample set 14 views 25c. Lieut. Walch, 50 Fort Greene Pl., Brooklyn, N. Y.

Wireless

Genuine Rusonite Crystals, tested and guaranteed. Mounted crystals postpaid, 50c. Trade discounts to dealers, manufacturers. H. J. Davis, 200 Ridgewood Ave., Brooklyn, N. Y

Something New in Radio. A unique crystal set design that will permit sharp tuning, cheap to construct. Send 25 cents, money order or coin, for blue print. J. F. Jeannin, 2248 Lawrence Ave., Toledo, Ohio.

Wireless (Continued)

This is Real Service—Panels cut to order, smooth sawed edges. We cut them exactly to size and ship the same day your order is received. ¼-in. thick, 1½c. per square inch; 5/16-in. thick, 2c.; ⅜-in. thick, 3c.; 7/16-in. thick, 3½c.; ½-in. thick, 4c. Why pay more? These radio panels are made of the highest grade black fiber. This material possesses high dielectric strength, is inexpensive, unbreakable and easy to work. Our special offer, radio panels 6x6x¼-in., 50c.; 6x12x¼, $1. We also carry a complete stock of fibre rod and tubes, the real thing for electrical insulation. Special prices quoted upon application. We pay postage. Radio Instrument & Panel Co., Box 75, Cicero, Illinois.

Attention! 50 Vacuum Tube Hook-Ups. The greatest collection of Vacuum Tube Circuits ever brought under two covers at such insignificant cost. These diagrams will be found in the great "Rasco" catalog, which contains raw materials and parts in a greater profusion than any other catalog. 15c. in stamps, or coin, will bring the catalog to you. Radio Specialty Company, 100 Park Place, New York City.

Boys! Don't overlook this. The "Rasco" Baby Detector. Greatest detector ever brought out with molded base. Fully adjustable. See former advertisements in this publication, or our catalogue. Detector with Galena Crystal complete, 50c.; the same Detector with Radiocite Crystal, 75c. prepaid. Send for yours today. Radio Specialty Company, 100 Park Place, New York City.

Build your own radiophone. Instruction book, ten cents. Radio Service Inst., U. S. Bank Building, Washington, D. C.

A-1 Galena—Perfect; tested and guaranteed; imbedded in special metal; price 35c., AA-1 Galena (Genuine) 50c., postpaid. National Specialties, 328 Union Sq., N. Y. C.

Build your own Radiophone Receiver. Complete Blue Prints Crystal Set $1.00. Audion Set $4.00. Radiophone Transmitter $1.00. Satisfaction guaranteed. Experimenters' Information Service, 45 Pinehurst Ave., New York. Bulletin X on request.

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless"—theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Stiff cloth cover, $1.75, postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York.

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The How and Why of Radio Apparatus, by H. W. Secor, E. E. This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general. A very broad field has been covered by the author, at the same time giving a great deal of information not found in other text books. If you are engaged in any branch of the Radio or allied arts at all you will surely need this latest contribution to radio literature, which is destined to be found on every radio man's book shelf before long. A glance at the following list of chapters gives but a very scant idea of the extensive and useful radio knowledge provided in its text: The Induction Coil; The Alternating Current Transformer; Radio Transmitting Condensers; The Spark Gaps; Radio-Transmitting Inductances; Radio Receiving Tuners; Radio Receiving Condensers; Detectors; Telephone Receivers; Radio Amplifiers; Construction of a Direct Reading Wavemeter and Decremeter; Antenna Construction; The Calculation and Measurement of Inductances; Appendix containing very useful tables, covering all subjects treated in this very unusual book. This newest of Radio Works, cloth bound in Vellum de Luxe, Gold Stamped and Hand Sewed, has 160 pages. Size of book, 6x9 inches. The How and Why of Radio Apparatus. Postpaid, $1.75. Experimenter Publishing Co. Book Dept., 53 Park Place, New York City.

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RADIOPHONE BROADCAST MAP
10 CENTS EACH
Size, 16 x 11½ inches

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In two colors ready to be mounted to hang over your radio set

Map also includes names, call letters and location of all broadcasting stations in the United States

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ELECTRICAL EXPERIMENTERS!!

SKINDERVIKEN TRANSMITTER BUTTON

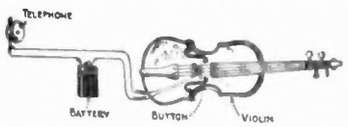
MOST SENSITIVE MICROPHONE

AS A PREMIUM

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

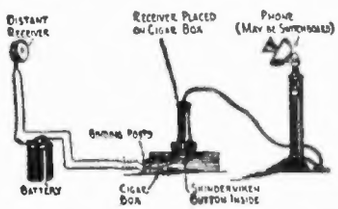
You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *This outfit was used by secret service operatives during the War. It is being used on the stage.*

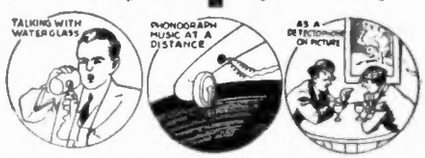
So much for its commercial adaptations! *You* can procure apparatus of the same type.



One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.



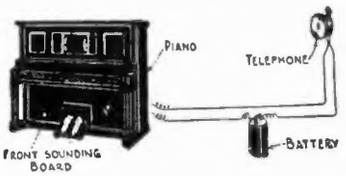


Actual size.

MR. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In the writer's opinion, obtained by actual elaborate tests, the Skinderviken Transmitter Button is probably the most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.



We have acquired a limited amount of these Transmitter Buttons and offer same free to our subscribers as a Premium, with a one year subscription to SCIENCE AND INVENTION. These Buttons sell everywhere for $1.00 and are worth it. We send you one prepaid upon receipt of the coupon below and the subscription price of our magazine. Do it today.

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THE Radio Specialty Co.—"Rasco" for short—is probably the most unique supply house in the United States, if not in the world to-day. This company makes a specialty of small orders, no order being too small to get immediate and prompt attention for the simple reason that most of our orders are small.

The reputation of this house was built upon service. Ask any of your acquaintances what they think of Rasco goods, Rasco service, Rasco promptness'. Thousands of unsolicited testimonials on file to prove that we serve the public best!

Be sure to get our great catalogue, containing several hundred different parts, which is illustrated below.

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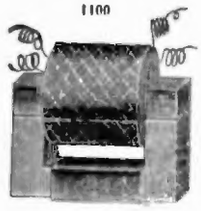


"RASCO" AUDIO FREQUENCY TRANSFORMER

We have compared many of the present transformers on the market but have finally decided upon a type that is the most efficient one we have seen so far. The best amplifying transformer is that in which the impedance of its primary is equal to or exceeds the impedance of the plate-to-filament circuit of the tube in which it is connected.

We guarantee this transformer to equal any one on the market.

No. 1100 "Rasco" Audio Frequency Transformer (not assembled) each prepaid $2.65

ANTENNA CONNECTOR

This antenna connector is made entirely of aluminum, is light and will not rust. The only connector of its kind. The 4 antenna wires go to the upper holes; the lower hole takes the lead-in. Don't solder your aerial, don't have loose connections. Dimensions 2" high, 1⅝" wide, ⅝" thick.

No. 999, Connector, each $0.35

999

PANEL KNOBS

6241

838

No. 6241 is well made and has a good corrugation. Its dia. is 1" height ½", hole 5/32". The shank is ⅛" high.

No. 6241, Knob, each $0.08

MARCONI KNOB

Has a central hole of 5/32" and seat to hold the screw. dia. is 1⅛", height ¾".

No. 838, Marconi Knob, each $0.15

RASCO POSTS

202 201

030 029

These are our very own patterns, from our own designs and look mighty handsome on any instrument. The top knobs are of composition, the bottom parts brass nickel plated polish.

650 651

No. 202 is nickel plated at bottom part.

"Rasco" Binding Post, 8/32 thread, each, $0.10; doz., $1.00.

No. 202, Post, each, ... $0.03

Nos. 650 and **651** made entirely in composition with a hexagonal brass nut in center.

No. 650 has 8/32 machine screw.

No. 651 has bottom wood screw.

No. 650, Post, each $0.08

No. 651, Post, each $0.08

Dozen, each style $0.90

BRASS NICKEL POSTS

No. 029, Binding Post, each $0.05

No. 030, Binding Post, each $0.04

75 1 2 3 4 5 6 7 77 76

RASCO SWITCH POINTS

Nickel plated and polished. The following have been found the most popular.

No. 1 ⅜"x⅜", 6/32 thread, ea., $0.03; doz., 35c

No. 2, 3/16" high, ⅜" dia., 6/32 thread, ea., $0.03; doz., 35c.

No. 3. 3/16" x 3/16", 4-36 thread, ea., $0.03; doz., 35c.

No. 4. ¼" dia.; ⅛" thick; stem 6/32, ea., $0.03½; doz., 40c.

No. 5, ⅜" dia., 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c

No. 6, 3/16" dia.; 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c.

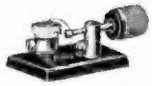
No. 7. 3/16" dia.; ⅛" thick; stem 4-36, ea., $0.03½; doz., 40c.

No. 75, Switch Stop. ⅞" long, 4-36 thread, complete with nut, ea., $0.05; doz., 50c.

No. 76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ⅛"; dia., 1/16" thick, ea., $0.03½; doz., 40c.

No. 77. same as above, but head is ¼" dia. x 3/16" thick, ea., $0.03½, doz., 40c.

THE RASCO BABY DETECTOR



1099

In presenting this little Detector, we feel sure that it fills a place never taken before by any small detector. It does a variety of things and does them all well and better than many $5.00 detectors. The base is solid, black composition. Mounted on same is a nickel holder and binding post which holds a fluted hard rubber knob with its sliding rod member.

The outstanding part of the Detector, is the patented nickel detector cup and binding post. The knurled cap unscrews and you place the Galena Crystal in the cup, then replace the knurled cap and the galena crystal is held secure. The circular hole in the cap exposes enough of the crystal for ordinary purposes.

No.1098, Rasco Baby Galena Detector. Price, prepaid $0.50

No. 1999, Rasco Baby Detector with Galena and Radiotic Crystals. Price, prepaid $0.75

PANEL SWITCH LEVER

New style switch lever with lock fork. It is impossible for this lever not to make positive contact at all times. The blade radius is 1¼". Blade is nickel plated and polished. Fork is phosphor bronze. The lock fork holds the screw (in which it rotates), securely. A loose contact is impossible.

200

No. 200, Switch Lever, complete as illustrated $0.30

LITZ WIRE

323

This wire is recognized as the only thing for winding coils for Radio Instruments. Particularly recommended with our No. 343 Variocoupler Rotor, for vario-couplers, banked windings, etc.

No. 323, Litz Wire, 20 No. 38 strands, enameled double silk wire, per foot, $0.02; per 100 feet, $1.15

No. 890, Litz Wire, 10 strands No. 38 wire, per foot, $0.01; per 100 feet, $0.75.

No. 891, Litz Wire, 16 cables of three strands No. 38 wire, per foot, $0.03; per 100 feet, $2.25.

NOTE: This page contains only a few of our 300 specialties.

PANEL KNOB

This is a very distinctive knob and can be used on dials, panels, switches, condensers, etc. It is exceptional and well made. Dia. 1 1/16"; height 11/16"; comes with 8/32" bushing.

815

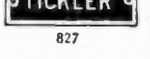
No. 815, Knob, each $0.18

VARIOCOUPLER ROTOR

343

This rotor is used by all up-to-date amateurs. Is accurately turned of hard wood and is used as a secondary coil. It takes any finish, either shellac or stain and can be drilled readily for any size hole. Large hole 2" dia. Width of spool is 2". Total dia. 3⅜".

No. 343 Variocoupler Rotor, each $0.75



827

"RASCO" NAME PLATES

839

Our name plates are of brass with a black background. Letters are polished nickel. Order by name and number.

		Each			Each
807	"Phones"	$0.05	810	"Ground"	$0.05
809	"Aerial"	$0.05	812	"Primary"	$0.05
811	"Secondary"	$0.05	814	"Detector"	$0.05
813	"Audion"	$0.05	866	"On"	$0.05
865	"Off"	$0.05	640	"Increase Current" (Left)	$0.10
839	"Increase Current (Right)	$0.10	834	"Series"	$0.05
813	"Vacuum Tube"	$0.05	830	"Receive"	$0.05
831	"Transmit	$0.05	620	"2nd Step"	$0.05
821	"3rd Step"	$0.0	827	"Tickler"	$0.05
819	"1st Step"	$0.05	825	"Plate Variometer"	$0.05
826	"Grid Variometer"	0.05	835	"B Battery"	$0.05
823	"Secondary"	$0.05	817	"Output"	$0.05
836	"A Battery"	$0.05	824	"Primary Condenser"	$0.05
818	"Input"	$0.05	828	"Parallel"	$0.05
829	"Telephone"	$0.05	837	"+ —"	$0.05
833	"Detector Tube"	$0.0	841	"(Blank) "(takes pen or pencil writing)	$0.05
822	"Coupling"	$0.0			
808	"Load'g Coil	$0.0			

Price of all of our name plates in dozen lots, 50c, with the exception of the two "Increase Current"

BAKELITE PANELS

350-55

We list below six panels, the sizes of which have been selected after carefully checking up many dimensions of the most popular radio apparatus on the market.

Note particularly that our prices are anywhere from 25 to 50% lower than those quoted by most other concerns. The reason is that we buy these panels in very large quantities, **and we do not cut sheets to order.** Remember always that when sheets are cut to order they cost you at least 50% more than our prices, because **you must pay for the cutting and the necessary waste.**

Note also that we ship these panels prepaid. This alone amounts to a considerable saving.

No. 350	6"	x 12"	x 3/16"	thick,	each	$1.90
No. 351	6"	x 18"	x 3/16"	"	"	2.85
No. 352	9"	x 12"	x 3/16"	"	"	3.00
No. 353	12"	x 18"	x 3/16"	"	"	5.65
No. 354	6½"	x 19½"	x 3/16"	"	"	3.50
No. 355	6"	x 7½"	x 3/16"	"	"	1.20

"RASCO" LUBRICATED PANEL SWITCH

1921

A radio switch that has two nuts at the end is a monstrosity, for the reason that it will never stay put. Our patent spring fork holds the switch handle always under uniform tension, at the same time it insures the best contact possible. New wiping contact, which covers every point of the switch point. Another new improvement is the lock fork, which can assume three different positions to accommodate the switch to various thicknesses of panels.

No. 1921 "Rasco" Switch, as illustrated, each $0.50.

KNOBS

199

4451

These knobs are favorites with all experimenters The size of both is: dia. 1⅛", height ¾". No. 4451 comes with 8/32 and 10/32 bushing.

No. 4451, Knob, each $0.06

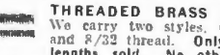
No. 199 (screw length ⅝") Knob, each $0.10

NAVY KEY KNOB

748

This navy key knob is now used on all standard wireless keys. It gives the right swinging mation and rests the fingers. It is a favorite with all advanced amateurs. Once used always used. The screw is 8/32 and will fit all keys.

No. 748, Key Knob, each $0.28



8032

THREADED BRASS ROD

We carry two styles, 6/32 and 8/32 thread. **Only 6" lengths sold. No others.**

No. 8032, Threaded Brass Rod 8/32 thread, per 6" length $0.08

No. 6032, Threaded Brass Rod, 6/32 thread, per 6" length $0.06

THE "RASCO" CATALOG

CONTAINS 50 VACUUM TUBE HOOK-UPS

Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few.—The V.T. as a detector and one-step amplifier; regenerative circuit; De Forest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; etc., etc. The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

15c in stamps or coin.

Radio Specialty Co.

This business was originated with the sole purpose to cater to the amateur who has small orders. ALL OF OUR ORDERS ARE SMALL and that is why your small order will never be sidetracked by us. A trial order will make you a life customer. Order from the above illustrations. "We can only stick you once." Try us with a 50c order. ALL GOODS PREPAID.

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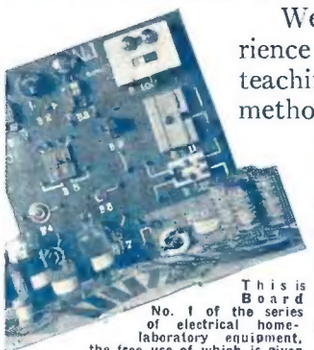
Learn Electricity This Wonderful New Quick Way

At Home in Your Spare Time

EVERY year hundreds of young men from all over the world come to the residence school of the School of Engineering of Milwaukee to learn electricity in all its phases. Yet we know that there are thousands of ambitious men everywhere who aspire to big jobs in the great field of electricity, but who cannot conveniently leave their present work to attend a residence school. It is to train these men that this extension division has been formed.

Just Like Going to School



This is Board No. 1 of the series of electrical home-laboratory equipment, the free use of which is given every student. (Size 24 by 24 inches.)

We knew from our long experience that the ordinary plan of teaching electricity by home-study methods would not measure up to the high standards set by the School of Engineering of Milwaukee. And so, this unique, new plan of giving each student free use of a complete home-laboratory system of actual working electrical equipment was conceived. We know that it is the only practical way to learn electricity at home!

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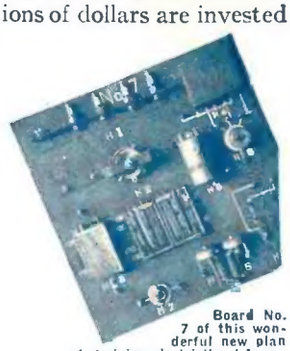
On this plan you can now secure almost every advantage of America's Greatest Institution of Electrical Education right in your own home! In this way this famous school now gives the most thorough, practical, intensive home-study course in electricity ever offered! It is a specialized, graded course, built up on the most advanced ideas of electrical instruction. Thorough, yet simple texts—graphically illustrated, give the electrical principles which logically parallel the practical experience gained in using the instrument boards. This amazing new method of extension instruction quickly makes any ambitious man a high-salaried, electrical expert!

Free Use of Special Electrical Apparatus

These wonderful, cleverly constructed instrument boards—equipped with actual, practical electrical apparatus—are furnished absolutely free to each student while studying. These laboratories are not toys—but include the same instruments and devices which the electrical man meets with in everyday work.

You Can Fill One of These Big Pay Jobs

The field of opportunity for the well-trained electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it—but the demand today is for men who are *trained specialists*. These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. Why don't you get into this fascinating, highly paid field of work? When you complete this course of easy study we will place you in a desirable position if you wish us to do so.



Board No. 7 of this wonderful new plan of studying electricity at home.

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